



Fire in Western Montana Ecosystems

**A strategy for accomplishing
Ecosystem Management through the
effective use of prescribed fire
in the Lolo National Forest**

March 1994

Fire in Western Montana Ecosystems:

A strategy for accomplishing Ecosystem Management through the effective use of prescribed fire in the Lolo National Forest

Orville Daniels,
Forest Supervisor
March 1994

Developed by:

Glenda S. Wallace
Writer/Editor

Dan W. Bailey
Forest Fire Mgmt. Officer

B. John Losensky
Forest Ecologist

Interdisciplinary Team providing updated Information, Technical Assistance and Evaluation

Vick Applegate,
Forest Silviculturist

Marcia Hogan,
Public Services/Wilderness Staff

Howard Roose,
Fire Management
Supervisor's Office

Dave Atkins,
Forest Planning

Rob Seli,
Fire Management Officer
Plains Ranger District

Troy Kurth,
Regional Office Fire Planner

Mike Hillis,
Forest Wildlife Biologist

Dave Stack,
Missoula District Ranger

Walt Tomascak,
Regional Office Fire Use Specialist

Skip Rosquist,
Forest Hydrologist

Richard Seitz,
Budget & Finance Officer

Richard Smith,
Plains Ranger District

Stephen Arno,
Research Forester
Intermountain Fire Sciences
Laboratory

Bob Meuchel,
Lolo Program Officer for Planning

Fred Stewart,
Forest Economist

Elizabeth Neill,
Landscape Architect

Robert Mutch,
Research Technology Transfer
Intermountain Fire Sciences Laboratory

Brian Riggers,
Fisheries Biologist

Vic Dupuis,
District Silviculturist

Skip Barndt,
Forest Soil Scientist

Original 1987 Interdisciplinary Team that developed the Ecosystem Maintenance Burning Strategy

B. John Losensky (Team Leader),
Zone Ecologist

Jerry Williams,
Fuel Management Specialist

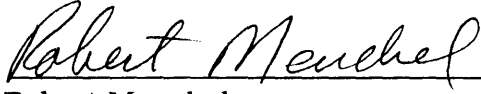
Vick Applegate,
Silviculturist

Doug Berglund,
Silviculturist

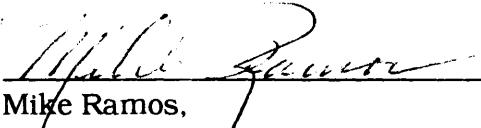
Jerry Delbert,
Wildlife Biologist

Skip Barndt,
Soil Scientist

Reviewed by:



Robert Meuchel,
Program Officer for Long Range Planning



Mike Ramos,
Program Officer for Administrative Support

Recommended by:



Charles Spoon,
Program Officer for Resource Programs

Approved by:



Orville Daniels,
Forest Supervisor

DATE: 2/2/94

CONTENTS

	Page
• Executive Summary	i
• The National Perspective	ii
• Ecosystem Management	1
• Fire in the Ecosystem	5
Fire Effects on the Lolo Forest --	12
• Planning	21
Fire's Historical Role in Lolo Habitats --	23
• Program Evaluation & Prioritization	36
Prescribed Fire Program Implementation Levels --	38
• Implementing Fire in the Ecosystem	43
• Funding Strategies & Partnerships	49
• Public Involvement and Education	53
• Monitoring	60
• Appendices	61

**The broader the field
of scientific inquiry,
the more difficult it becomes to limit and
define that field. Ecology, as the broadest
of the biological sciences, is also the most
indistinct. Since Ernst Haeckel in 1866
proposed the term oecology, from the Greek
oikos meaning house or place to live,
the term has been applied at one time or
another to almost every aspect of scientific
investigation involving the relationship
of one organism to another, or to the
relationship of an organism
to its environment.**

From Forest Ecology,
Third Edition

Background:

Since the early 1960s, staff on the Lolo National Forest have been committed to utilizing prescribed fire in forest management activities, primarily for site hazard reduction and preparation for planting trees and/or natural regeneration after logging, and for wildlife habitat improvement. However, by 1985, research was indicating that fire had to play a larger, more defined role. In 1987, a long-term ecosystem burning strategy was adopted. Since its implementation, the use of prescribed fire, outside traditional hazard reduction silvicultural treatments, has increased on the Lolo by about 2,500 acres per year. Now, with the five-year review of the Lolo's Forest Plan revealing a need for even more burning to sustain healthy forests and increase big game forage, and since timber sale activity and its related prescribed burning is decreasing, it's timely to look at increasing the forest's Ecosystem Fire Program to more realistic levels and to meet Forest Plan goals.

Purpose:

This document/plan concludes that ecosystems in the forest require periodic fire for long-term sustainability. It provides a general assessment of fire's effect on ecosystems and develops strategy levels for minimal to optimum burning.

Strategy:

While simple in theory, this plan is complex in application to the landscape. Because fire has been excluded in areas that naturally saw fire's influence every five to 80 years, plant communities have changed and unnatural fuel buildups are occurring. Plus, more people are living near forested areas, air quality is becoming more critical, and larger, more devastating wildfires are occurring. Balancing the environmental, social and political issues involved in utilizing ecosystem fire will not be an easy task. However, this plan provides a thorough analysis and a sound foundation for implementing an effective and cost efficient ecosystem fire program.

Program:

This plan will increase the use of prescribed fire on the forest to meet ecosystem management needs. Since the decrease in traditional burning programs will occur at the same time ecosystem burning will increase, it is estimated that burning levels will only increase by 15-25%. This will not dramatically increase air quality problems. Based on analysis, it is recommended that the Lolo begin a five-year, staircase program to increase ecosystem burning that will fully meet Forest Plan goals by 1998.

Proposed Ecosystem Fire Program by Year and Acreage

FY94: 3,200 ac.	FY95: 4,000 ac.	FY96: 6,000 ac.	FY97: 10,000 ac.	FY98: 12,000 ac.
-----------------	-----------------	-----------------	------------------	------------------

Cost:

Over the past five years, costs and funding options have been the biggest obstacle to a fully implemented ecosystem fire program. This plan improves current and out-year cost projections and includes planning, preparation work and direct burning costs.

Proposed Ecosystem Fire Program by Year and Cost

FY94: \$100,000	FY95: \$150,000	FY96: \$205,000	FY97: \$500,000	FY98: \$800,000
-----------------	-----------------	-----------------	-----------------	-----------------

Process:

The program will be managed by a four-person, forest-level oversight team, consisting of the fire management officer (team leader), budget & finance officer, wildlife biologist and silviculturist. This team will be responsible for setting program levels, including monitoring and evaluation, and funding. Each Ranger District should evaluate its specific program to determine program management responsibilities.

**"Ecology has to do with relationships
between organisms and their environments.**

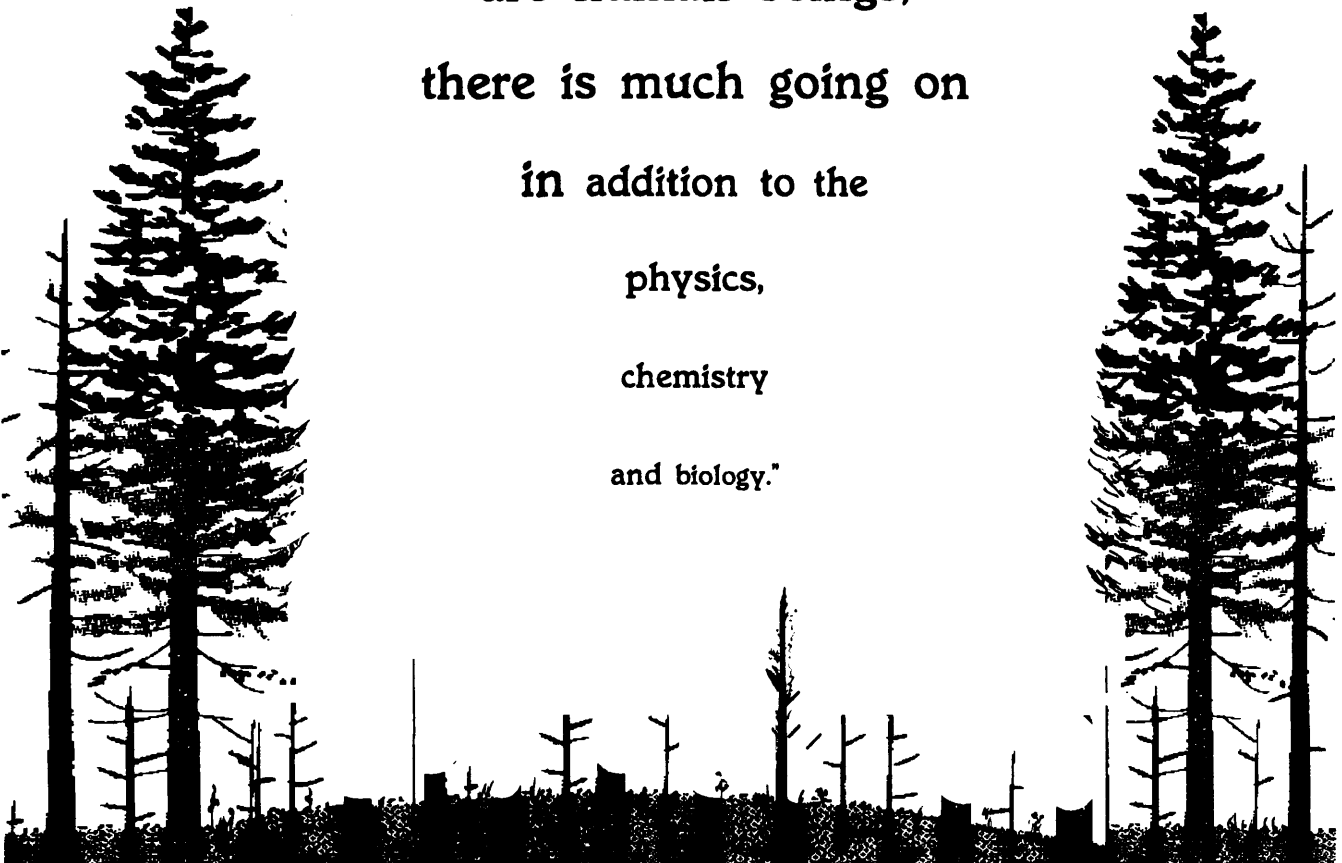
**The science of ecology
focuses on understanding the
physical, chemical, and biological interactions
that take place between
organisms and their environments;
but when the organisms in question
are human beings,
there is much going on**

in addition to the

physics,

chemistry

and biology."



From the USFS paper "Ecology of the Heart" by Herb Schroeder

THE NATIONAL PERSPECTIVE

Over the past three years good progress has been made experimenting with more environmentally sensitive ways to manage the national forests and grasslands. A lot was learned from field demonstration projects, research efforts, and university symposia and workshops under our New Perspectives program. What we learned is that ecosystem management works, and that it's where we need to head with our research program and the management of the national forests and grasslands.

In May of 1992 it was decided that it was time to take what we have learned and implement a new forests and grasslands management philosophy called Ecosystem Management. In simple terms, we've been courting the ecosystem approach for three years. We like the relationship and the results. So today, we're announcing the marriage: The Forest Service is committed to using an ecological approach in the future management of the national forests and grasslands. By ecosystem management, we mean that an ecological approach will be used to achieve multiple-use management, for the needs of people and the nation's forests and grasslands. It means that we must blend environmental values in such a way that the national lands represent diverse, healthy, productive, and sustainable ecosystems.

Because the public forests and grasslands are dynamic and complex ecosystems, they will change over time whether managed by people or not. In a global framework, our forests play a vital role. They are the lungs of the earth, absorbing carbon dioxide and giving off oxygen. They also serve as an important air filter by taking pollutants out of the air and storing them in the forests. These are important reasons why we must put the management of national forests and grasslands on an ecological basis. Our management and care is essential to providing diverse and productive habitat for wildlife and fisheries, clean water and air, and outstanding opportunities for outdoor recreation, natural wood products for American families, and long-term stability to the ecosystem.

We know this is a tall order, but we believe we're now in a good position to do it. With our knowledge, expertise and experience, along with a stronger public involvement effort, we can bring the American people and their needs together with the land they own, and do it better than it has ever been done before by anyone in the world. That's our challenge under this new policy of ecosystem management.

U.S. Forest Service -
Washington Office
June 4, 1992

The Lolo National Forest



ECOSYSTEM MANAGEMENT

Blending the needs of a healthy forest with the needs of the American people --that's what the U.S. Forest Service (USFS) wants to accomplish with its Ecosystem Management policy, announced in June of 1992. At its heart, the policy focuses on sustaining the productivity, resiliency and diversity of natural ecological systems.

Since fire has a profound influence on the lands in the National Forest System, which totals 191 million acres, land management plans that incorporate ecosystem management must consider fire as a natural disturbance with some benefits.



Photo: U.S. Forest Service

This document explains the principles of ecosystem management; examines the role of fire and the effects of its exclusion, through suppression, on ecosystems (particularly those in the Lolo National Forest); and suggests options for implementing a more progressive prescribed fire program. Because people are part of the fire restoration equation, the sociological impacts of an ecosystem fire program will also be explored.

Intended for both an internal and external audience, portions of this document may appear extraneous to many Forest Service staff while seeming too technical for a general reader. Some portions will be appended to the Forest Plan of the Lolo National Forest.

So, what is Ecosystem Management and what does it mean to the people who manage and use Forest Service lands?

In November of 1993, when the policy was presented to U.S. Senate agricultural committees, ecosystem management was described as "a holistic approach to natural resource management...."

"...It's an approach that steps back from the forest stand and focuses on the forest landscape and its position in the larger environment.... Ecosystem Management means considering the whole fabric of our natural resources as we make decisions; understanding and preserving the vital connections between land, water, wildlife, vegetation, and human beings; and assuring that we provide the values, uses, products, and services desired by the public in a sustainable manner."

In effect, land managers within the U.S. Forest Service are being asked to develop a greater understanding of the ecosystems under their stewardship. With this more intimate knowledge of each forest, its place in the landscape, and the elements (including people) that influence it, land managers can make choices that both serve the interest of the land and the public who need amenities and commodities from it.

It was the public's concern--shared by Forest Service staff--that "the nation's forests not be managed as giant tree farms," according to the 1990 Annual Report of the Lolo National Forest, that prompted a more ecologically aware Forest Service: "The fear is that traditional forestry practices may be creating simplified ecosystems, that we may be losing things we not only don't understand, but that we don't even know exist," the report says. In the Kootenai National Forest's guide to Ecosystem Management, one manager suggests that what is happening within the Forest Service is a "paradigm shift," which is a "distinctly new way of thinking about old problems."

"...Consider the example of hidden objects in a drawing. You cannot be persuaded into seeing the objects. Either you see them or you don't. Once you see them, they are plainly visible each time you see the picture and you wonder how you missed them before. New Perspectives in Forestry [was] a paradigm shift. The focus of national forest management has changed from uses extracted from the forest (e.g. timber, minerals, hunting) to ecological and sociological values."

Ecosystem management moves the Forest Service one step further. It directly addresses *forest* health and it recognizes that in today's society a walk through a pine forest is as valuable as the timber taken from it. It announces that the USFS intends to use the land, as it must, but in a way that will maintain the vitality of the system. And it acknowledges the human role in nature and just how humans can learn from it. In the final analysis, ecosystem management is the first step in an evolutionary process.

From Forest Perspectives

To observe how the new policy was being implemented on-the-ground, an interdisciplinary team from USFS headquarters visited the Northern Region, including stops at the Superior and Ninemile Ranger Districts of the Lolo National Forest, in May of 1993. After their tour, the team's primary observation was that land managers "at all levels and disciplines of the organization" were "dedicated and enthusiastic" about ecosystem management, according to a June 2nd memo from team leader and forest ecologist Rob Mrowka.

Lolo Forest managers say this is because ecosystem management makes sense. It's what their own management philosophy has been evolving toward, since the New Perspectives initiative, which generated considerable new data about the two-plus million acre Lolo Forest. Thanks to a guide called *Sustaining Ecological Systems*, distributed by the Northern Region, as well as a number of forest-specific studies, Lolo managers have a better understanding of the ecological principles needed to guide their activities. Yet, under ecosystem management, they'll need even more information about the forest. They'll need an intimate understanding of biology on a grand geologic scale.

Speaking as acting USFS chief before the Senate's Subcommittee on Agricultural Research, Conservation and Forestry, and the General Legislation Committee on Agri-

culture, David Unger announced that the underpinning of a successful ecosystem management policy is science. In fact, he calls for an "...accelerated scientific effort [with] the efficient incorporation of science into on-the-ground projects."

What the science of the past decade has shown researchers is that traditional practices meant to eliminate environmental threats from the forest are not producing healthy forests. Despite the USFS's best efforts, forest ecosystems are changing, and it's because the forest cannot be protected from natural disturbance, like wildfire, insects and disease, without disturbing the balance of the entire ecosystem. These forces are a part of the natural cycle of change and renewal. According to the third edition of Forest Ecology by Stephen Spurr and Burton Barnes: "...fire was second only to precipitation as the major factor shaping the character of forests" before 1940 and the era of fire protection."

So, if forest ecosystems need renewal, and fire is one of the major agents of change in the renewal of ecosystems, the best land managers can do is understand how fire and other environmental factors, including human use, shaped the prehistoric landscape and how they influence it today, and make decisions that will support the sustainability of the ecosystem.

A healthy forest is an ecosystem in balance.

Yet the concepts of ecosystem balance and function are difficult to define in the absence of a model. We have indicated the condition [before European settlement] as a possible standard for our efforts. We have also indicated that this condition was not static. We must be more interested in forest processes than any final condition.

Kootenai National Forest
Guide To Ecosystem Management

Incorporating this new understanding of ecosystems into Forest Service projects means incorporating the philosophy of ecosystem management into national forest plans. Because of what Forest Service staff call *Nifma*, the 1976 National Forest Management Act (NFMA), all national forests are required to have a comprehensive management plan, called a Forest Plan, which sets down the desired long-range conditions and goals for a forest. (The Lolo was one of the first in the Northern Region to produce such a plan. Its final version, after much internal and public debate, was published in April of 1986.)

Because NFMA regulations require that the conditions on lands covered by forest plans be reviewed regularly, to see whether conditions or public demands have changed significantly, the Lolo Forest Plan has been reviewed. An interdisciplinary team of Lolo specialists found in 1993 that conditions had changed. Specifically, they found seven issues, including the need to implement the new ecosystem management policy, that will affect changes to the plan.

Proposed Updates to the Lolo Forest Plan

Big Game Winter Range - In some areas, modify limits on thermal cover not needed to protect animals from extreme cold. Expand the role of fire in these areas to increase the amount of forage.

Ecosystem Management - Plan should recognize the role of fire, insect & disease in the ecosystem.

Elk Security - Monitoring should include whether enough habitat exists for increasing big-game animal populations.

Heritage Program - The Plan's standards for finding & saving cultural resources should include interpretation for visitors.

Livestock Grazing - To preserve water quality and streambank erosion, livestock grazing in riparian areas must be reduced.

Threatened & Endangered Species - Sensitive species (less-threatened-but-still-at-risk) will be included.

Wilderness - Recognize its value as a whole. Prevent and eradicate noxious weeds in the Bob Marshall Wilderness Area.

Specifically, the Lolo's five-year review indicates that in order to meet Forest Service objectives fire must play a larger role in Forest ecosystems. In particular, it suggests that fire is needed to increase forage on big game winter range, and that the plan should recognize "the vital roles" that fire, insects and disease play in forest ecosystems.

Coincidental to this five-year review, fire was also mentioned as "the largest missing or suppressed ecological process in the analysis areas" by the USFS headquarter observers who visited the Northern Region in 1993. The team leader's followup memo reads:

"To restore fire to its natural role will necessitate burning large numbers of acres annually. It is questionable whether other processes can successfully and totally mimic the role of fire. At the same time questions of smoke management, and public acceptance casts a shadow on how many acres of burning can be accomplished."

As USFS fire management officers know, returning fire to the ecosystem with its once natural frequency and intensity may not be possible in many areas, particularly around wildlands that have vacation homes or bedroom communities adjacent and often--given the layout of national lands--right within them. In those instances, Lolo managers foresee using a mixture of prescribed fire and other silvicultural techniques (see Implementation chapter) to minimize potential impacts to other resources, particularly those family homes.

But, however accomplished, the goal of ecosystem management is to recognize the needs of invaluable and intricate ecosystems. They are constantly changing, yet finely balanced entities. Fire is part of the balancing act, and yet to restore *fire* on a scale that approximates its natural role in the ecosystem will not be easy. It will require research and cooperation. It will require a concentrated effort in technology transfer. USFS findings must not only be passed onto the public, but shared between departments, for practically every function of the USFS has a vested interest in fire's return to the ecosystem--from the silviculturist who must decide what techniques will best cultivate the forest, to the biologist who oversees wildlife habitats, to the recreation manager who provides hikers with interpretive trails and scenic spots for picnics. All these individuals, plus the hiker and the hunter and the homeowner, must contribute to allowing fire to take up its natural role in the ecosystem. ■

FIRE IN THE ECOSYSTEM

The Blue Mountains of northeastern Oregon and southeastern Washington, the Colorado Front Range west of Denver, the central Sierras in California, and the mountains of southern Idaho. What do they all have in common? Serious forest health problems that have been caused inadvertently by past use and management of these lands, according to the USFS staff briefing paper *Fire Related Considerations and Strategies in Support of Ecosystem Management*.

In particular, the experts are finding forest health problems in the short-interval, fire-adapted ecosystems--the ecosystems that have historically had fire as a frequent visitor. When fire scorches a tree, left behind as a dark layer in the annual growth rings is the dead cambium. This historical record shows land managers that in parts of the Pacific Northwest there are cedar-spruce forests that haven't felt the effects of fire for as long as 2,000 years.

However, in the ponderosa pine forests of North America, fire is a frequent visitor--as often as every five years in some places. In Oregon's Blue Mountains, fire swept through lodgepole pine stands every decade or two, and it was, in fact, the smoke from natural wildfires or those set by Native Americans that gave the mountains their name. The forests of western Montana, which includes the Lolo National Forest, also burned with enough frequency, historical records indicate, to create a constant hazy condition in late summer.

George E. Gruell in a 1985 article entitled *Fire on the Early Western Landscape: An Annotated Record of Wildland Fires 1776-1900* reports that after a search of scientific and historical literature, which included personal journals, he found mention of 145 fires in the "interior West," which includes Montana, Wyoming, Idaho, Utah, Nevada and Eastern Oregon.

"...Reports show that very large fires occurred in the forested regions of northwestern Montana during exceptionally dry years. One of these burned about 853 square kilometers (530 square miles) in 1889 on the Lewis and Clark Forest Reserve (presently Lewis and Clark, Flathead, and Lolo National Forests...."

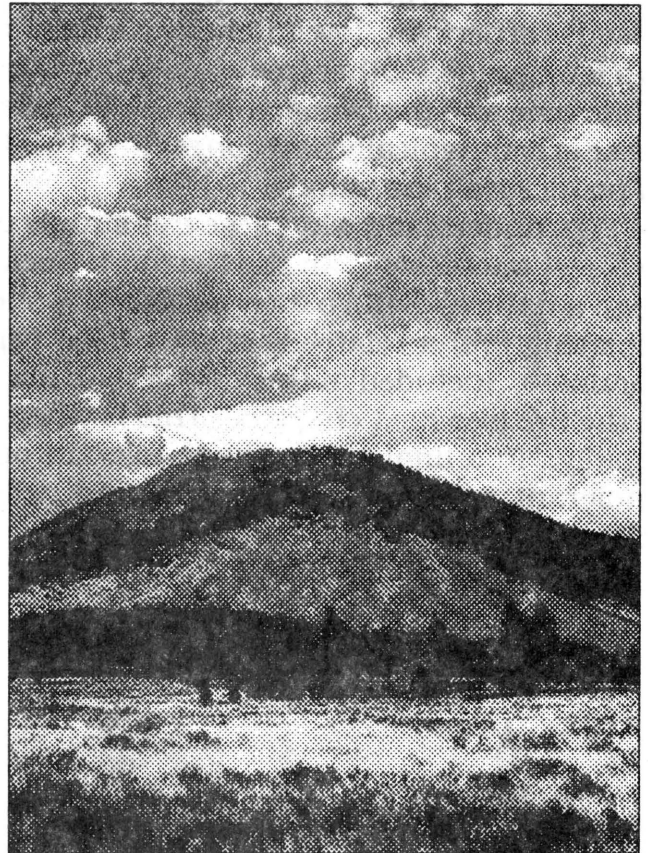
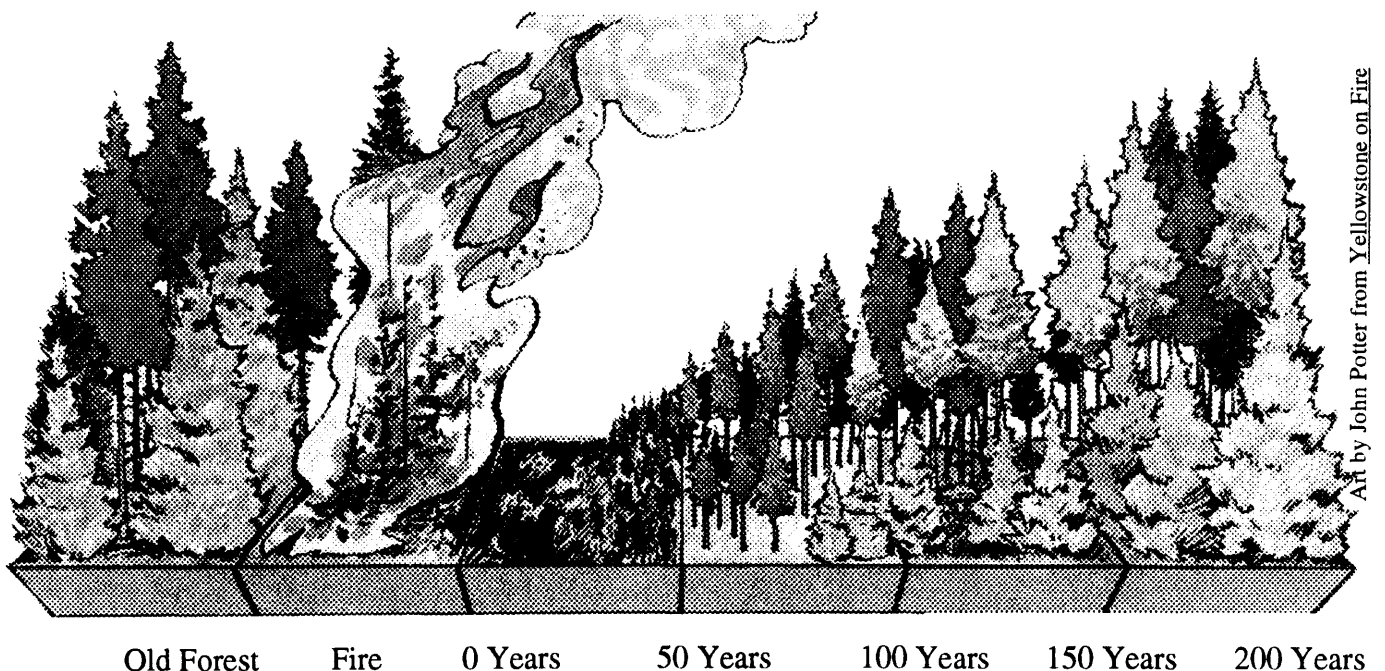


Photo: SW Montana prescribed-fire forest mosaic - U.S. Forest Service

Fire research shows that wildfire on the early landscape varied by region, depending on weather and fuels. As the above account indicates, in drought years it was particularly prevalent. Forest managers refer to this varying rate of return as the "range of natural variability." On the contemporary landscape this range has been stretched beyond the natural, and it's where the serious forest health problems are developing.

The ponderosa pine and western larch are common tree species found in short-interval, fire-adapted ecosystems. On the Lolo Forest, they're typically found along valley bottoms up to the mid elevations. Since, the 1930's, experts have been studying these long-leaf pine types like the larch and the ponderosa. What they've found is that in the absence of periodic, low-intensity surface fire, stands of these trees undergo change within a few decades. Other tree species found on the Lolo, such as the lodgepole and western white pine and the Douglas-fir, also experience change if fire is excluded from them, but these stands typically have longer intervals between fires and the fire is more intense than in ponderosa pine stands.

To understand why these tree stands undergo change is to understand competition in forest succession. In the Northern Rocky Mountains, where wildfire has historically been a natural disturbance, research is showing that after a severe fire (called a stand-replacing fire) a relatively short period begins in which grasses, forbs, and/or brush dominate. Included in this new growth are the tree species that existed on the site prior to the fire (see next chapter). This is when the trees that require open sunlight develop rapidly. In a final stage, shade-tolerant or climax species germinate below the shade-intolerant or early seral species and, without disturbance, eventually these shade-tolerant species dominate the site.



For example, neither the larch, ponderosa or lodgepole pine are shade tolerant trees. They grow best in full sunlight on soil that has been bared of duff, which is the organic material that accumulates on forest floors. Fir and spruce, on the other hand, will grow in shade. So, eventually, these species will replace a lodgepole pine stand in 100 to 250 years, and establish a climax forest. Until a fire starts the cycle again, these species will remain as dominants.

In their 1987 report *Fire Ecology of Western Montana Forest Habitat Types*, forest researcher William Fischer and plant ecologist Anne Bradley conclude that wildfire plays a major role in forest succession in western Montana. Before the European settlement of the Northern Rockies, experts say, many forest types rarely reached climax conditions because of fire, insect and disease.

Not so today. University of Washington Forestry Professor Chad Oliver is adamant that Americans must "overcome the image of a pristine climax forest" as the sign of a healthy ecosystem. In a March 1993 *Horizon Air* article about the prescribed fire program underway in Oregon's Blue Mountains, author Eric Lucas describes the professor's wince as he speaks about the modern history of treating fire as the enemy.

But, if fire is not the foe, how does it help trees like the ponderosa and lodgepole pine? It gives them a competitive edge in forest succession.

The ponderosa pine with its thick fire-resistant bark has a particular advantage. When fire visits ponderosa pine stands with its natural frequency, which is from five to 30 years on the Lolo, these forests are kept relatively free of underbrush, which preserves the open, park-like conditions that early settlers noted,

Fire in the Trees of the Lolo National Forest

Ponderosa Pine (*Pinus ponderosa*)-

Has many fire resistant characteristics, including development of insulative bark. Seedlings and samplings often withstand fire and can maintain themselves on sites with fire intervals as short as six years if fire severity is low. Pine seedling establishment is favored when fire removes the forest floor litter and grass and exposes mineral soil. Since this pine is among the most fire-resistant trees growing in Montana, it has a competitive advantage over most other species when mixed stands burn.

Lodgepole Pine (*Pinus contorta*) -

Individual mature lodgepole pine trees are moderately resistant to surface fires. Though thin bark makes it susceptible to death from cambium heating, the lodgepole is unique in its ability to perpetuate itself on a site despite fire. Indeed, on most sites where lodgepole grows, fire is necessary for the species continued dominance. Without periodic disturbance, shade-tolerant species replace lodgepole because it does not regenerate well on duff [the organic matter on the forest floor] or under shaded conditions.

Whitebark Pine (*Pinus albicaulis*)-

Moderately fire resistant. Its thin bark is susceptible to hot surface fires that heat the tree's cambium. It's a midtolerant species that has been observed as a pioneer inhabiting recently burned sites.

Western White Pine (*Pinus monticola*)-

Moderately resistant to fire. However, it depends on severe fires to recycle stands and create an early successional habitat. Mineral surfaces provide a better seedbed than duff surfaces.

Rocky Mountain Juniper (*Juniperus scopulorum*)-

Large junipers often survive a number of (cool) fires because bark thickens and crown develops a bushy, open form. Young trees are easily killed by fire.

Continued on next page

Fire in the Trees

of the Lolo National Forest

Douglas-Fir (*Pseudotsuga menziesii*)-

Mature Douglas-fir is a relatively fire-resistant tree. Saplings, however, are vulnerable to surface fire because of their thin, photosynthetically active bark, closely spaced flammable needles, resin blisters, and thin twigs and bud scales. Fire resistant bark takes about 40 years to develop on moist (favorable) sites.

Grand Fir (*Abies grandis*)-

Individual mature grand firs can resist low to moderately severe fires primarily because of their thick bark. However, a low and dense branching habit, highly flammable foliage, heavy lichen growth, relatively shallow root system and dense stand habit make it susceptible to fire injury and death. Fire resistance is strongly influenced by site.

Subalpine Fir (*Abies lasiocarpa*) -

Least fire-resistant species in the Northern Rocky Mountains.

Western Larch (*Larix occidentalis*)-

The most fire-resistant conifer in the Northern Rocky Mountains. Possesses an insulating bark that can, in mature trees, range from 3 to 6 inches (7 to 15 cm) thick. Fire resistance is enhanced by tendency to self-prune lower branches. Because it replaces its needles annually, defoliation by fire is less traumatic.

Subalpine Larch (*Larix lyallii*)-

Though its thin-bark is easily damaged by fire, the subalpine larch is moderately fire resistant primarily because of its stand habit. It grows only on the highest elevations in rocky and generally moist and cold sites.

Western Redcedar (*Thuja plicata*)-

Low to moderate fire resistance because of its thin bark, shallow root system and low dense branching habit. Despite this, it often survives because of its large size.

Continued on next page

and virtually eliminates the threat that exists today of large, stand-replacing wildfires. Without the periodic presence of fire, Douglas-fir is dominating the areas where ponderosa pine now occurs.

The lodgepole pine is perhaps even more fire dependent than the ponderosa, for fire is often the key to unlocking its seed. Many lodgepole cones are serotinous, meaning cones remain on the tree for one or more years without opening. When wildfires visits the site, the heat opens the resinous cone and its large quantities of seed are released. Fischer and Bradley note that "on sites below about 7,500 feet (2,2896 m), the role of fire in seral lodgepole forests is almost exclusively as an agent that perpetuates or renews lodgepole pine."

When fire does come, it usually burns the entire stand--in great part, because the lodgepole is a prolific species. Not only do lodgepole trees as young as five years old on open sites produce viable seeds (which can remain viable for up to 80 years) seedlings can establish and grow quickly on recently burned sites. Eventually, however, most sites become so overstocked, the stand becomes stagnant and susceptible to snow breakage, windthrow, insect and disease, which creates a build-up of dead woody fuel, virtually guaranteeing an intense fire, which wipes out the stand and starts the process again.

Of particular concern to researchers in western Montana is the whitebark pine, found in high-elevation ecosystems across western North America and considered an important food source for such wildlife as Clark's nutcracker, the black bear and the threatened grizzly. Whitebark is also important in protecting watersheds by stabilizing soil and rock on the harshest sites and by catching and retaining snow-pack, according to the article *Rapid Decline of White-bark Pine in Western Montana: Evidence from 20-year Remeasurements*.

The authors, Stephen Arno and Robert Keane of the USFS's Intermountain Research Station in Missoula, Montana, cite that the decline of the whitebark pine is occurring because of introduced disease, an insect epidemic, and "successional replacement by shade-tolerant trees in the absence of fire." (The whitebark pine is succeeded mainly by the subalpine fir.) Arno and Keane found an average mortality rate of 42% over the last two decades and suggest that "management treatments such as *prescribed fire* can serve to maintain whitebark pine in the landscape."

Also being reported by Arno and others is that prescribed fire favors the western larch, which needs fire's disturbance to compete with more shade-tolerant evergreen conifers. In parks and natural areas where fire is excluded, the western larch is declining and could become scarce, Arno cites in a co-authored paper presented to a 1992 symposium on *Ecology and Management of Larix Forests*.

More than 20 tree species exist on the Lolo National Forest. The sidebars on pages 7 through 9 list the effects of fire on many of these species. Research continues into the effect of fire on the understory of the forest. So far it's revealed that fire is crucial for regeneration of a number of species including the wax currant and the evergreen ceanothus, which need fire for seed stimulation.

Perhaps the most important feature of fire in the ecosystem is that it creates a forest in a variety of successional stages. With its tendency to skip stands of trees, fire can create forest mosaics or patches on the landscape that are not at climax vegetation. And since a forest with many successional stages within its boundaries provides a variety of food and cover, more species of wildlife can live in the area than if it were all were in a state of uniform vegetative climax. In effect, habitat variety means ecosystem health because the entire community has a better chance of surviving if its parts are varied. If everything is uniform, like a field of wheat, then disease or fire can wipe out the entire field.

Although fire can be kept from an area for long periods, it will return eventually. And when fire is excluded from fire-dependent pine forests, species take over that are not as fire- and drought-resistant as pines. Couple that with the developing understory and the likelihood that a fire will consume all trees in the stand greatly increases. In other words, the reservoir of fuels that once were consumed on a regular basis by low-intensity fires, now fuel a high-intensity canopy burn.

Fire in the Trees of the Lolo National Forest

Aspen (*Populus Tremuloides*) - Aspen is characterized as shade-intolerant species that is very sensitive to, but very dependent on fire. Its thin bark makes it easily killed even by low intensity fire. However, fire removes the forest cover from aspen stands and stimulates resprouting for new aerial shoots to become trees. In the absence of fire, many stands would slowly die due to over-topping by other shade tolerant tree species.

Mountain Hemlock (*Tsuga mertensiana*) Only slightly more fire-resistant than sub-alpine fir. It invades burned sites in high-elevation forests.

Western Hemlock (*Tsuga heterophylla*) Easily killed by fire because of its thin bark, shallow roots, flammable foliage and low branching habit. Its tendency toward dense stands increases susceptibility to fire.

Englemann Spruce (*Picea engelmannii*) Easily killed by fire. Large old spruce may occasionally survive one or more light fires, but deep accumulations of resinous needle litter around their base makes them particularly susceptible to fire damage.

From: *Fire Ecology of Western Montana Forest Habitat Types* by William Fischer & Ann Bradley.

Prescribed fire is being credited with saving the short-interval, fire adapted ecosystems in the southern portion of the United States. Prescribed burning there has been ongoing since the 1930's, when Southerners began returning to the practice of "light" burning, which settlers, timber owners and livestock growers in the south and the west favored at the turn of the century. Those early pioneers knew from their own observations and experience that burning off underbrush or "light burning" improved grasslands for livestock and reduced the likelihood of larger, more destructive fires. Since the 1930's, it's been understood that prescribed fire can also help trees. Research has shown that pines will flourish in the South's warm and humid climate if repeated fires are allowed to keep down the hardwoods.

The Great Northern Rockies Fire of 1910, which burned about three million acres on the Montana/Idaho border, is credited with putting a virtual end to prescribed burning in much of this country, according to history professor and Montana state legislator Harry Fritz, speaking at a 1992 conference on the politics of wildfire:

"Prior to 1910, a controversy raged among forest professionals over the advantages, or lack thereof, of light or prescriptive burning. The 1910 fires ended that one conclusively in favor of outright prevention.... The Fire of 1910 mesmerized, traumatized, a long succession of Forest Service chiefs...."

Fritz, basing his comments on Stephen Pyne's book Fire in America, says the 1910 fire crystallized the Forest Service's "sense of mission" and dedicated it to "the proposition that forest fires are preventable evils.

Purposeful burning did not become an accepted practice again in this country (except in the South) until the late 1960's. The change came about as a result of two developments. First, the Leopold Commission mandated in 1963 that land managers

The Fires Before European Settlement

Lewis and Clark noticed many fires on their travels across the continent, from 1803 to 1806. Along the upper Missouri River, they saw Indians using fire to lure bison across icy rivers. After a spring fire, bison would be attracted to the new, green grass that was a tasty change from the dry, brown unburned grass of winter. In trying to reach the new grass, the bison would find themselves marooned on ice flows



and would float downstream where waiting Indians would make easy kills....

In a letter to John Adams in 1813, Thomas Jefferson noted that Indians would drive game by walking in circular groups and using fire to compensate for their lack of numbers. Jefferson rightly suggested western America's grasslands existed in large part because of Indian fire hunting.

From "Fire, The story behind a Force of Nature," by Jack de Golia

preserve the scenery along "with the forces that make it." And, second, research was finding important ecological relationships among plants, animals, and fire.

The commitment of the Lolo National Forest and its fire managers to the benefits of prescribed fire also dates back to the 1960's. Like on other forests, it's been used primarily in conjunction with timber harvesting. After a logging project, silviculturists prescribe fire to reduce hazards on the site and to prepare it for planting and/or natural rejuvenation. The Lolo Forest has also had an ongoing burning program to improve wildlife habitats.

In 1985, Forest Supervisor Orville Daniels recognized that fire needed to play a larger, more defined role in forest management activities than that of hazard reduction and site preparation. He ordered an interdisciplinary team to review the situation and create a policy that recognizes "the role of fire and proper silvicultural practices in maintaining a near natural ecosystem in harmony with its environment."

That policy was adopted and implemented in 1987. It's based in part on forest ecologist Jack Losensky's 1984 inventory of fire effects on the Lolo (see next chapter) where he concluded that without some type of consistent fire in the ecosystem, the system can be expected to deteriorate. He recommended that to assure a healthy system "efforts must be made to reintroduce natural processes, including fire, into the system."

Though the 1987 burning program tried to do this, the five-year review of the Forest Plan has indicated that the prescribed fire program on the Lolo still hasn't gone far enough. Before the arrival of white settlers, approximately 50,000 acres burned annually. This figure is based on the frequency of fire's return to particular ecosystems (see the table on page 14). In the past three decades, since 1960, about 150,000 acres have burned through prescribed fire treatments. If another 150,000 acres that burned as the result of wildfire are added, the average acreage burned only amounts to about 10,000 acres a year (or about one-fifth of presettlement fire frequencies).

Increasing the amount of ecosystem burning on the Lolo, however, isn't as simple as saying it. One of the hindrances is public perception. Prescribed fires have been viewed with suspicion since the Yellowstone National Park fires of 1988. Among the media hype of "letting" fire destroy Yellowstone, the policy of *wilderness prescribed fire*, which lets natural fires or fires started by lightning burn themselves out, became confused with *prescribed fire*, which is ignited after careful preparation. Also lost in the confusion were the benefits of fire in the ecosystem, which this document highlights. ■

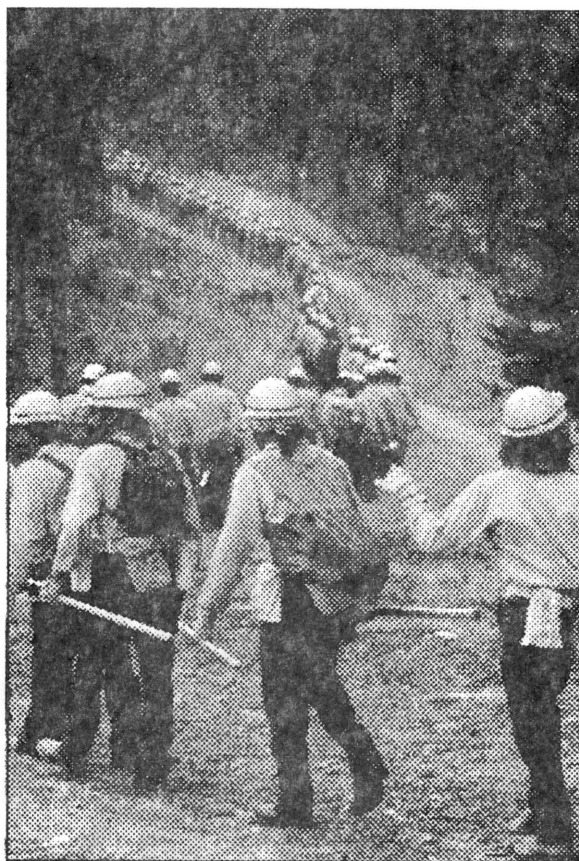


Photo: Yellowstone in 1988 - National Park Service

Fire Effects on the Lolo Forest



Fire has been recognized as a major influence in the Rocky Mountain ecosystems for many years. As early as 1900, J.B. Leiberg of the US Geologic Survey discussed fire and its impact on vegetation communities in his description of the forest vegetation of the Bitterroot Forest Reserve.

Leiberg concluded that repeated fires in the preceding 200 years were responsible for the age of the trees in the reserve and he attributed these fire-starts to either the acts of Indians or, more recently, white settlers. He thought there'd been an increase in fire frequency since the advent of white settlers. Apparently he did not recognize lightning as an ignition source.

During this period of history, timber waste caused by careless burning and poor utilization of the resource was common. Concerned people found it difficult to accept that any burning was beneficial. Leiberg stated that, "the aftereffects of the fires in this region are various, but are always evil, without a single redeeming feature."

Some, however, did not agree with this view. In 1928, according to the Bitterroot Valley Historical Society, an early settler of the Bitterroot Valley, Frank Jaquette, in relating the events surrounding the murder of William Rombough, stated:

"At this time (1887) the creek (West Fork Bitterroot River) was thoroughly set with a growth of willows and very completely so on the south side. Since it has become part of the white man's domain and fires are less general and frequent, the large alder growth has very generally replaced these willows. It might be noted here that the Indians were great foresters, as all old-time prospectors will affirm. They left the forests to the tender mercies of nature which perfected a fine

Service spends millions of dollars battling against nature's force, the result is a tendency to a scrubby growth of timber and a fire trap."

In formulating early fire policy, however, Jacquett's view was apparently outweighed by Leiberg's report and the 1889 and 1910 fire years, for up until the 1970's, land managers were required to immediately suppress all fires.

With time, however, ecologists and managers recognized two important factors which affected their perception of fire in the Rocky Mountain ecosystem: 1) that lightning played a major role in ignition of many of the fire starts; and 2) the vegetational communities of the region evolved over thousands of years with fire as an important influence. Although these concepts were recognized by a few individuals, fire continued to be thought of as detrimental to the ecosystem both by researchers and the general public. Recent research and subsequent policy changes in the management of wilderness fires have provided an opportunity to rethink our basic fire policy for all lands.

Basic Fire Concepts

Although the concept that our forests evolved in the presence of fire is now generally well accepted by the scientific community, the recognition of the ecological significance of this interaction is just now gaining common understanding.

Much of the early research viewed fire as an external disturbance of an otherwise stable vegetative system. This view suggests that forest succession is an expression of the resiliency or ability of the ecosystem to recover from fire or other disturbance. This approach is based on the classic concept of succession, or "relay floristics," in which seral or pioneer plants modify the site to their own exclusion to permit establishment of interseral and climax species. Recent studies do not support application of this model in the Northern Rockies under natural fire conditions.

An alternative presented by Jack Lyon and Peter Stickney in their 1976 paper *Early Vegetal Succession Following Large Rocky Mountain Wildfires* suggests that fire should be treated as an internal disturbance of the ecosystem. Under this premise, forest succession is modeled as a sequential development of dominance during which the forest community reverts to its prefire structure with some random variations in composition and duration of seral stages. These stages do not alter the general developmental sequence or eventual structure of the community. This model is referred to as "initial florestics" in which species found in the climax community are present in the seral community. While

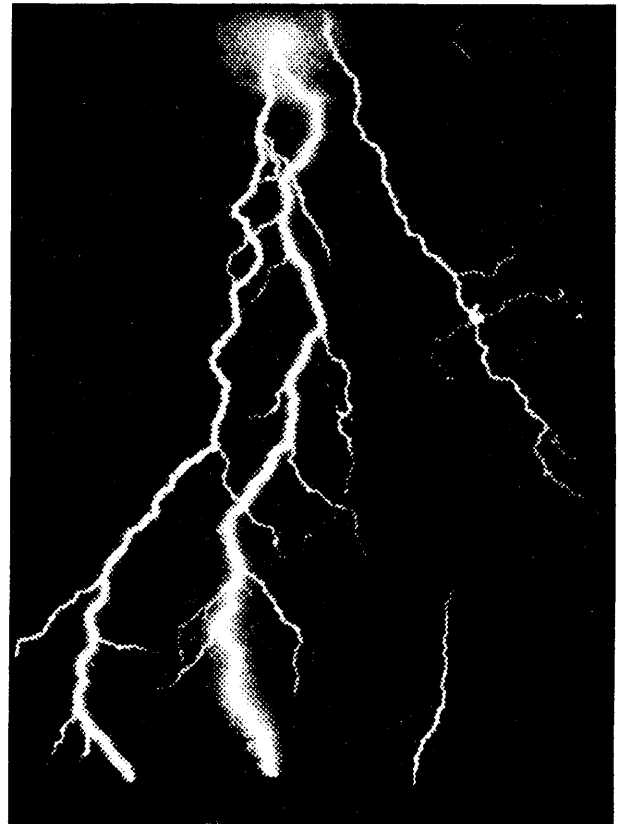


Photo: A common and historical fire-starter - U.S. Forest Service

there are exceptions to all biological models, this approach seems to best fit the ecosystems found in the Northern Rockies.

Based on the concept that fire is an internal part of the ecosystem, the next logical question becomes "What portion of the ecosystem is not operational when fire is removed from the system?" Conceptually, the concern is no longer one of damage to the system by fire, but one of damage to the system by the exclusion of fire. With this concept in mind, a review of potential impacts of fire exclusion is explored for the Lolo Forest vegetation.

Natural Fire Frequency and the Percent of Area Affected for the Lolo National Forest		
<u>Average Fire Frequency</u>	<u>% of Lolo Forest</u>	<u>Acres*</u>
5 - 10 years	8	170,000
10 - 30 years	31	650,000
30 - 80 years	34	700,000
80 - 150 + years	13	300,000
Limited Fire Impact	14	300,000
* Figures are rounded off. Total acreage of Lolo National Forest is 2,083,192.		

Fuel Buildup and Nutrients

One of the most obvious results of fire exclusion is the accumulation of dead material. These fuels are composed of snags, branches, leaves, dead grass and other herbaceous plants. This is of particular importance in the Northern Rocky Mountain area because of the dry, cool climate which retards the decomposition rate of this material. Also with fire exclusion, more shade-tolerant species (commonly less resistant to fire damage) will increase in the plant community.

The net result is an increase in the biomass occupying the site. Fuel buildup of both live and dead material may result in a fire of greater intensity or size than expected under natural conditions. This increases the risk of damage to the soil and water resource.

Of equal concern is the unavailability of nutrients for growth because they are tied up in these fuels. Since the decomposition rate is slower than the accumulation rate over major portions of the Northern Rocky Mountains, fire plays an important role in moving nutrients locked in these fuels back to the soil medium.

Excluding fire can result in nutrient deficiency on some sites predisposing a stand for what G.I. Vasechko, in his 1983 article *An Ecological Approach to Forest Protection* referred to as the "aged crash of forest." This is a common phenomenon on shallow soils or where the effective depth of the soil is limited. On these sites the mature or dominant trees grow normally until the resources of nutrient substances and soil moisture are

exhausted. When this occurs, many trees lose their resistance and are attacked by pest insects or become subject to windthrow because there is not enough available or unoccupied soil to support a root system large enough to maintain tree stability. This view is supported by studies in lodgepole pine where trees under stress from decay fungi in the roots were preferentially attacked by mountain pine beetle. This was reported by John Gara and others in the proceedings from the Lodgepole Pine Symposium in 1984.

In addition, there appears to be a correlation between the natural fire frequency and productivity of the site. Drier (poorer?) sites have a higher frequency of burning than mesic (more productive) sites. While some work has been done to describe nutrient availability in our stands, no corollaries have been made to growth loss or what constitutes a threshold point triggering a crash as described by Vasechko.

Studies are just now providing insights into nutrient availability at various stages of a stand and it does seem reasonable to assume that once the fire frequency period is exceeded by some undetermined time period reductions in growth may occur, particularly on the drier sites.

On the Lolo Forest, approximately eight percent of the forest has a normal fire cycle of 10 years. Based on past suppression activity this means that portions of the area may be up to eight times beyond the normal fire cycle. On 31 percent of the forest, the cycle is closer to 30 years and the fire-free period could be double the normal condition. The remaining area could be at, or considerably less than, the normal frequency.

Insects and Disease

The interrelation between mountain pine beetle, lodgepole pine, and fire has been well documented in the Northern Rocky Mountains. The two forces--mountain pine beetle and fire--are key to the maintenance of lodgepole pine over millions of acres. Removing fire from this relationship has resulted in a shift in stand composition with many of the lodgepole stands on the forest now containing a dense stand of subalpine

fir in the understory. In time and with the continued exclusion of fire, these trees will cause increased stress on the lodgepole pine overstory making them more susceptible to bark beetle attack. (Since 1982, 25,000-50,000 acres have been annually infested. That figure declined in 1993 to 17,000 acres, nearly the level of infestation that existed in 1981.)

The end result is often the conversion of the stand to subalpine fir. This shift is counter productive from a timber production standpoint in that subalpine fir, generally, has slower growth rates. Regeneration costs may be higher, and wood properties and wood uses are less satisfactory than lodgepole pine.

Fire also plays a role in the control of dwarf mistletoe by periodically destroying the stand and



Photo: Signs of Mountain Pine Beetle - US Forest Service

eliminating the source of infection. Currently, mistletoe is considered a major problem on 17 percent of the lodgepole pine stands.

The relationship between fire and spruce budworm severity has been documented by David Fellin, and others, in their 1983 report *Western Spruce Budworm in the Northern Rocky Mountains*. It states:

"The western spruce budworm was not recognized as a serious threat to coniferous forests in the Northern Rockies until 1922, when two infestations were reported.... The first significant outbreak in the geographic area covered by the U. S. Forest Service's Region 1 began about 1948 and has persisted until now. The extent, persistence, tenacity, and stability of the western spruce budworm in the Northern Rockies probably has been strongly influenced by past fire management policies and partial selective cutting practices. Before

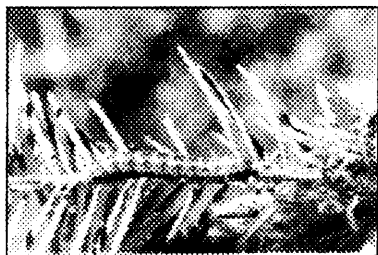


Photo: Western Spruce Budworm larva - USFS

white settlers entered the area, frequent light ground fires burned through most ponderosa pine/Douglas-fir forests. These fires retarded the establishment of understory thickets of Douglas-fir. The more recent absence of fire in Douglas-fir and spruce/subalpine fir forests has altered stand structures and forest successional patterns, resulting in an increasing proportion of shade-tolerant, budworm-vulnerable host species such as true firs and Douglas-fir."

On the Lolo Forest, this change can affect up to 56 percent of the forest.

The influence of fire on disease pathogens is not well documented. Recent studies by Susan Hagle and Donald Goheen, reported in the proceedings from a 1984 symposium on pests in Douglas-fir and grand-fir forest types, suggest that while wildfire nor broadcast burning have significantly reduced root pathogen inoculum on sites, it may indirectly control fungus by favoring tree species which are more resistant. Because the fungi is dependent on host tissue for survival, exclusion of susceptible species by fire could result in a decline of the fungus over time.

Regeneration and Stand Composition

It is evident that there is an ongoing shift in stand composition as a result of fire exclusion. Changes in composition restrict the opportunity for certain types of silvicultural treatment and may result in a young stand composed of species which are suboptimal from a production standpoint. In addition, stands composed of fire-intolerant species are less stable and are subject to a number of damaging agents increasing the risk of a major loss during the life of the stand. Presently about 38 percent of the forest is undergoing a major shift in stand composition from fire-maintained species to less fire-resistant species.

Not only does the tree component change as a result of fire exclusion, but ground cover does as well. On some types with normal light ground fire, graminoids dominate the understory and shrubs are limited, giving the stand a park-like appearance. With fire exclusion, the number and size of the shrubs increases and over time the composition of the understory will change to a shrub-dominated community. Areas where early settlers were able to ride their horses freely through the forest are now difficult to walk through. This influence is currently impacting about 20 percent of the forest.

Wildlife

Much of the winter range resource on the Lolo is composed of shrub range, dependent on periodic fire for optimum forage production.

In this type, the average frequency of fire is 30 years, but because of fire protection some of these areas have not burned for 80 years or more. In this time, according to monitoring results and local research, forage production on winter ranges has fallen by more than a third while elk populations have gone from near extinction to an all time high. There are several compensative factors that have prevented major winter die-offs, but if fire-dependent winter ranges are not restored, a major reduction in elk population is inevitable.

Study of bighorn sheep suggests that open visual areas are important for the health of the herd. Encroachment on these fire-maintained open areas may cause the sheep to become sedentary and subsequently susceptible to lung-worm pneumonia. The bighorn sheep population on the Lolo Forest is of national significance and its loss or decimation would have far reaching effects.

There are also bird species dependent on fire or that take advantage of a forest burn. For example, the blackbacked woodpecker, like most woodpeckers, eats the beetles that come in after a fire and creates cavities in the dead standing trees, which provides a home for the mountain bluebirds that follow. Dark-eyed juncos and the western wood pee wee also find advantage in recent burns.

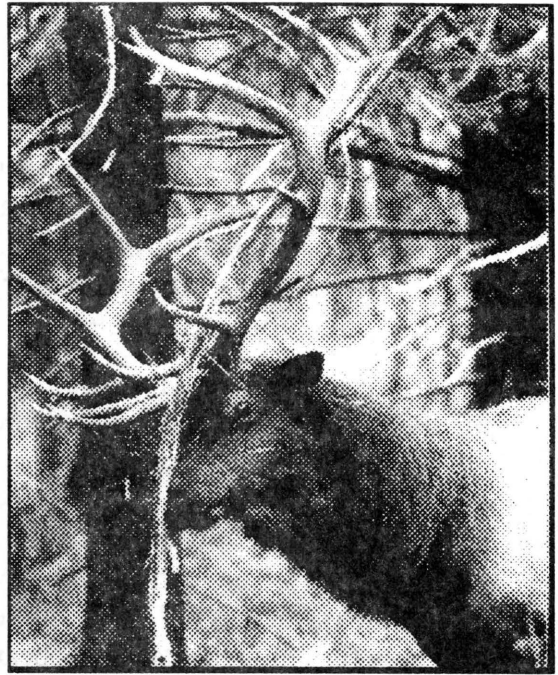


Photo: Rocky Mountain Elk Foundation

The above is from J. Losensky's 1984 report *An Assessment of Fire Effects on Lolo National Forest Ecosystems*.

The Nutcracker and the Pine:

For the third time in a generation a major American forest tree is in danger of becoming too rare to continue as a functional member of its ecosystem. The others have been the American elm and the American chestnut, which were, like whitebark pine, victims of introduced diseases..

The non-opening cones and heavy wingless seeds of whitebark pine force it to rely on a bird---Clark's nutcracker---for seed dispersal. Because the nutcracker caches them just below the soil surface, the whitebark pine seeds can germinate, and seedlings can become established. Once the pine population is reduced to an unknown minimum density, there will be no nutcrackers to disperse seeds and establish seedlings because there will be too few cones to attract them.With fires excluded, there will be fewer cache sites attractive to nutcrackers. Thus the local loss of whitebark pine means lessened biodiversity in the subalpine zone, and it sets in motion a positive feedback loop that makes the pine increasingly unable to become re-established.

- From the editorial by Ronald M. Lanner in the April 1993 *Western Journal of Applied Forestry*.

Fire and Water

According to the USFS general technical report *Effects of Fire on Water*, water is perhaps the most sensitive component in the ecosystem when vegetation and soil are disturbed. Researchers have been studying the response of water to "forest cover alterations" since the early 1900's. What they've found is a natural link between fire and water. The 1978 report, prepared for a national USFS Fire Effects Workshop, concludes that "although the effects of fire on water resources vary widely across the United States," there are some common responses:

- (1) Fire exerts pronounced effects on basic hydrologic processes, leading to increased sensitivity of the landscape to eroding forces and to reduced land stability....
- (2) Erosion responses to burning are a response to several factors including: degree of elimination of protective cover; steepness of slopes; degree of soil nonwettability; climatic characteristics; and rapidity of vegetation recovery.
- (3) Sedimentation, increased turbidity levels, and mass erosion appear to be the most serious threats to water resources following fire (especially wildfire)....
- (4) ...Large fires of high intensity appear to have the greatest potential for causing damage to water resources.

These last two points are particularly significant to fire managers and watershed specialists. The effects of wildfire (and its suppression) are thought to have more impact on watersheds than prescribed fire does. According to the workgroup that prepared the fire effects report on water, "Prescribed fire plans normally include protection of the water resource and the aquatic habitat; therefore, the effects on water would be expected to be generally of lower magnitude than with wildfire." The effect of silvicultural practices, including prescribed fire, on water has been studied by the USFS since the 1960's.

Areas where natural fire sequences are interrupted is where, more often than not, intense wildfires occur. Intense wildfires mean intense consumption of vegetation and intense heating of soil, and the bottom line is a severe watershed response.

We will probably never fully grasp all the intricacies and complexities of the components and processes of the ecosystems under our stewardship. It is hoped we will never have to face the consequences if we don't retain the productivity, sustainability, and diversity of our ecological systems. To avoid this, it is strongly recommended that throughout our management activities we follow the first principle of conservation--what Aldo Leopold said in 1949:

**"To keep every cog and wheel
is the first precaution of intelligent tinkering."**

Kootenai National Forest
Guide To Ecosystem Management

USFS research into the effects of fire on water continues with even greater importance under the ecosystem management philosophy. One byproduct is better understanding by fire managers on how watersheds (streams, riparian areas, wet meadows, seeps and other hydrologic features) affect fire on the landscape. When a forest includes wet areas, the fire distribution pattern changes. In effect, watersheds help create needed forest mosaics.

Conclusions

In October of 1984 Jack Losensky concluded (from his research into fire effects on the Lolo National Forest) that continuing a policy of fire exclusion on the forest would result in some direct costs to the ecosystem (see following page). In his report *An Assessment of Fire Effects on Lolo National Forest Ecosystems*, he noted that prior to the arrival of white settlers approximately 50,000 acres burned annually. Since 1960, about 300,000 acres have burned (through prescribed fire treatments and wildfire), which averages out to 10,000 acres annually or about one-fifth of the historical fire frequency:

"If this trend continues, additional accumulations of fuel and a continuing shift in stand composition to more fire-susceptible species will result.

Lolo ecosystems cannot be maintained by the present fire exclusion practices and continued deterioration of the system can be expected. A goal to optimize ecosystem balance may be partially achieved by proper silvicultural practices; however, efforts must be made to reintroduce natural processes, including fire, into the system in a planned manner to assure a healthy system.

For these reasons I recommend the Lolo adopt a policy of total ecosystem management, which includes the use of fire along with proper silvicultural practices to maintain a near natural ecosystem in harmony with its environment."

Based on his recommendations, an interdisciplinary team was appointed to develop specific prescriptions by habitat type for each of the Lolo's management areas. The policy they developed was implemented in 1987, but for a number of reasons, including funding and staffing levels, the Lolo was never able to achieve this recommended optimum burning level of 12,000 acres annually.

With the call for ecosystem management throughout the Forest Service, fire managers on the Lolo see a new opportunity to use fire in a systematic manner, not only to achieve commodity outputs, which continues to be a necessary function of the Forest Service, but to meet the more important goal of maintaining a balanced vegetative community. The rest of this document will highlight the role of fire both in the habitat types, lumped into habitat groups for ease of reference, and the management areas found on the Lolo Forest. It will also lay out the steps needed to implement a total program of ecosystem burning. ■

Summary of Fire Exclusion Effects

Research shows that there will be short- and long-term impacts on the Lolo Forest ecosystem if we continue a policy of fire exclusion. These impacts can be translated into some direct management costs to the ecosystem and commodity outputs:

- Fuel buildups can result in a larger number of higher intensity fires. The frequency of burns of this intensity may also be higher than normal, resulting in a long term deterioration of the soil resource.
- Since fire is an important part of the nutrient cycle, particularly on the drier sites which are also normally those that have a restricted total nutrient pool, it follows that fire exclusion can result in nutrients being unavailable to plants or soil organisms.
- Not only is the stand more vulnerable to insect and disease, but the food supply for insect pests is significantly greater in less fire-tolerant species. Pathogen buildup in the litter and duff could be increasing the likelihood of infection to less fire-tolerant species.
- With fire exclusion, stand composition will shift to species that are less fire-tolerant. These species are more vulnerable to insect attack, disease infection, and are more nutrient demanding.
- Reduced growth and increased stress will amplify the impact of drought or other environmental factors.
- Increased risk of damaging wildfire.
- Reduced forage value for wildlife.
- Loss of ecosystem processes.
- Loss of species richness.

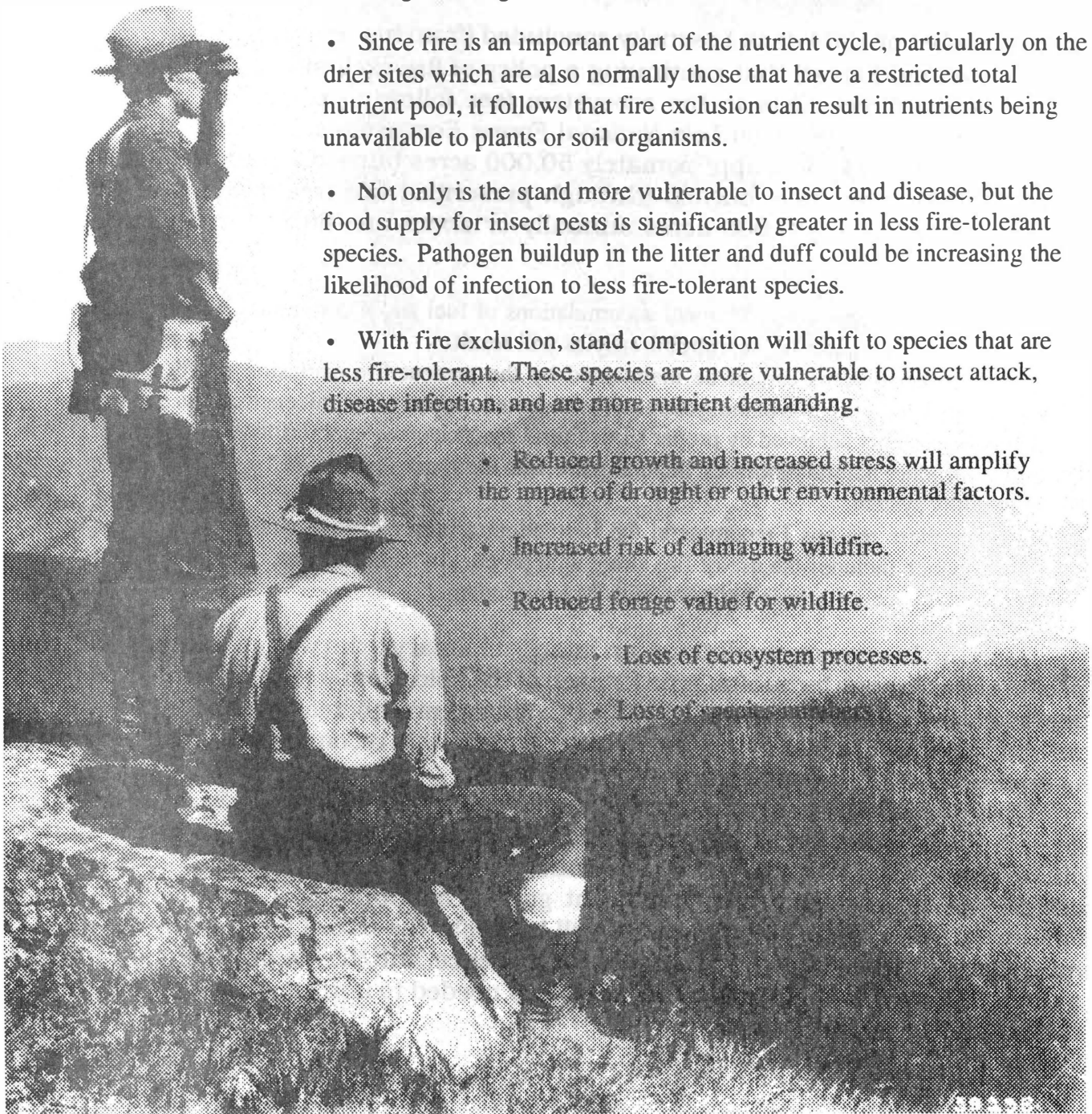
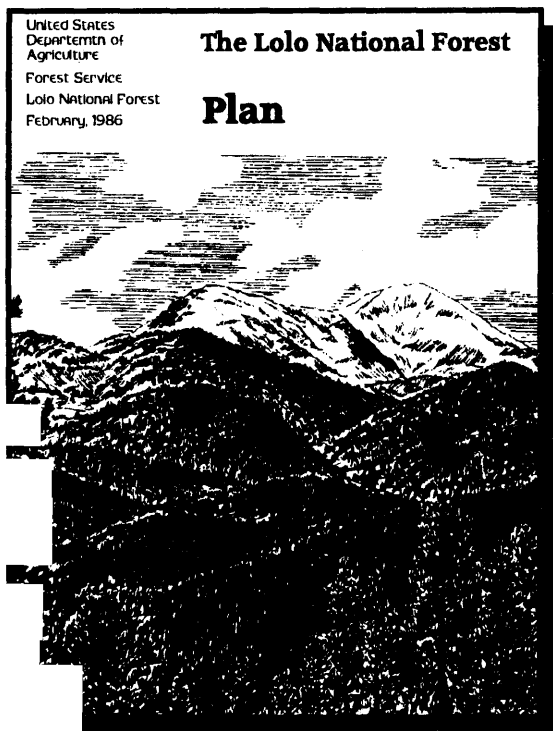


Photo: US Forest Service (1930)

PLANNING

In terms of forest planning, Ecosystem Management has provided a new opportunity for the ranger districts within the Lolo National Forest to reexamine their project planning. In the past, they've concentrated on small-scale projects to accomplish the objectives of Forest Plan management areas (see Appendix A). Now, they can work from a larger geographic perspective or from a landscape scale. This broader context not only allows Lolo managers to better understand the ecosystems and habitats they oversee, it provides them with an opportunity to better define, and so more consistently complete, the analyses required by federal law.



Integrating Ecosystem Management into Lolo Forest planning has become a three-phase process developed to meet the intent of two federal acts: The National Forest Management Act (NFMA), which directs how Forest Service lands should be managed, and the National Environmental Policy Act (NEPA), which directs the process of making any changes to the land.

The first step of the integration process was to locate analysis areas within the landscape of the Lolo Forest called Ecosystem Management Areas (EMA). Each EMA is large enough to represent physiobiotic communities where interacting natural processes can be studied, analyzed and modeled. Based on the Hierarchical Framework of Ecological Units developed by the Forest Service (with input from other federal and private organizations), these EMA's give Lolo managers new perspective of their forest's needs.

In the second phase, EMA's are closely examined. Specifically, land managers study the area's existing condition, which Dean Apostol, landscape architect and co-author of Landscape Analysis and Design, describes below:

"It boils down to this. The forest landscape as we know it in 1993 is a product of natural processes, aboriginal land management, and "modern" management over the past 150 years or so. It is neither entirely natural nor entirely person-made in most cases, though there are exceptions to both. Every landscape we will prepare plans for has some existing "pattern" to it that is there because of non-human and human-influenced processes. This is the existing

condition. We describe it using some organized landscape analysis process, hopefully using the language of landscape ecology to help clarify and unify otherwise distinct "resources." Thus, the "analysis" part of Landscape Analysis & Design is just that... analysis. From it we can develop a reasonable understanding of the patterns and processes at work in that landscape. But nothing in the analysis per se will tell us what it is we ought to do in that landscape in the future."

It's during the second phase that forest managers determine what, if any, projects are needed. They do this by comparing the existing condition to the expectations of the Forest Plan. In other words, planners analyze the area from a geographic perspective (using the EMA). They then check the goals and expectations of the management areas within the EMA as outlined in the Forest Plan and determine specific management actions. Also included in the equation are possible public concerns and issues.

Further analysis and actual project design come in the third phase, known as the NEPA Compliance phase. It's at this point that a thorough environmental analysis of the project begins. If the project is expected to have a "significant impact" (as defined by NEPA guidelines) the Forest Service begins an environmental assessment or environmental impact statement.

Detailing the Lolo Landscape

To help land managers "clarify and unify" their resources, the USFS has been designing a number of ways to inventory the landscape. On the Lolo Forest, vegetation has long been classified into habitat types (see next section). Now, staff are looking at the forest in terms of Land System Inventory (LSI) units, which are based on landform, geology, soil and vegetation. Specifically, LSI units have similar topography, elevation, precipitation, and potential types and amounts of fuel buildups.

Similar LSI's and habitat types are further grouped into the Landtype Association or LTA, which was developed to provide the type of landscape scale information project planners will need under ecosystem management.

Those interested in understanding how fire behaves on a particular site are pointed to the Fire Management Analysis Zones (FMAZ). Based on habitat type and LSI's, the FMAZ gives fire managers a way to measure fire behavior by knowing the amount of vegetation on a site. FMAZ's also consider the potential for public concern. See Appendix B for a complete list of FMAZ's, but as a general guide they can be defined as follows: FMAZ 1 represents low elevation vegetation, with a 10-20 year fire frequency. FMAZ 2 contains the highest biomass on the Lolo, signalling concern for wildfire. FMAZ 3 consists of very steep slopes. FMAZ 4 represent high elevation areas, where fire occurs, but rarely. FMAZ 5 is designated wilderness areas where fire operations are guided by other management goals, and FMAZ 6 is Lolo forest land protected by the State of Montana, Department of State Lands.

Also of particular help to USFS forest managers is the Fire Effects Information System data base, which includes the fire effects and related biological, ecological and management information for nearly 300 plant species in 34 forest and range ecosystems. Also included in the data base is the effect of fire on plant communities and associated animal species. For information on how to access this data base, see Appendix C.

Fire's Historical Role in Lolo Habitats



Photo: Typically fires burn faster going uphill - US Forest Service

The two-million-plus acres of land that makes up the Lolo National Forest ranges from moist valley bottoms to dry alpine slopes. Due to the influence of maritime and continental climate patterns, the Lolo has a diversity of plant species and extremely patterned vegetation types. In effect, the Lolo Forest represents a transition from maritime-like to continental climates, and the vegetation reflects this transition.

For land management purposes, the Lolo Forest has been divided into management areas (MAs) based on land uses. More than two dozen MAs are listed in the Lolo Forest Plan. They range from sites with prime timber and good wildlife forage to administrative sites and areas of designated wilderness. In each MA, the use of prescribed fire is addressed.

Also covered in the Forest Plan are the habitat types classified on the forest. For ease in management planning, they've been organized into seven groups, similar to those described by forest researchers William Fischer and Ann Bradley in *Fire Ecology of Western Montana Forest Habitat Types*. In the following pages, each habitat group is explained in terms of its natural structure and the role fire has historically played in it.

Also included in this section is the Fire Grouping of each habitat type. Developed in the Fischer and Bradley report mentioned above, Fire Groups are based on habitat types and how their tree species respond to fire, particularly during successional stages. Only 10 of the 12 Fire Groups identified in that report apply to the Lolo Forest. See Appendix D for a complete listing.

Habitat Group O - Non Forest

The group represents a mix of various vegetative conditions, all of which are classed as non-forest or noncommercial forest land. Fuel loading and fire intervals are highly variable and fire normally has a limited impact on the plant communities.

Habitat Group O (189,719 Total acres on the Forest)		
<u>Habitat Type</u>	<u>% of Habitat Group.</u>	<u>Fire Group</u>
Alpine & Barren	1.0%	0
Scree	84.9%	0
Mountain Grassland	5.8%	0
Rockland	3.4%	0
Meadows	2.4%	0
Mountain Brush	2.6%	0

Alpine & Barren -

These sites are found only on the highest elevations on the Lolo Forest. Vegetation is composed of graminoids, cushion plants, or krummholtz type trees on very rocky sites.

Fire Group O

Based on tree species response to fire and its role in forest succession.

A heterogeneous collection of special habitats that have limited use of prescribed fire

Fire has played a limited role in these types and they will not be considered for fire treatment other than as inclusions within another type.

Scree, Forested Rock and Rockland -

These communities are characterized by significant amounts of rock or rock fragments. Some areas are treeless, but generally they support an open forest cover. They are often found on steep, dry, south to west facing slopes. Tree species found include ponderosa pine, Douglas-fir, lodgepole pine, aspen and subalpine fir. Other species found on the Lolo Forest may also be observed in this community. Undergrowth is sparse and highly variable.

Because of the rock and discontinuous vegetation, these sites can be almost unburnable and fire frequency is highly variable. Recovery is generally slow and invader species such as noxious weeds pose a major threat once the ground is disturbed. For these reasons, fire use must be applied with care.

Meadows -

This community is composed of herbaceous matter growing on sites that are subirrigated part, or all, of the growing season. The major type on the Lolo Forest is Deca/Carex as defined by Mueggler and Stewart (1978). Soils are usually deep and poorly drained. Species composition is dominated by hairgrass (Deschampsia) and sedge (Carex).

Wheatgrass (*Agropyron*) and fescue (*Festuca*) are conspicuously absent and forbs are normally limited to cinquefoil (*Potentilla*), pussy-toes (*Antennaria*) and doorweed (*Polygonum*). Shrubs are absent or limited to huckleberry (*Vaccinium*).

Past beaver activity played an important role in maintaining conditions which were favorable to this community type on portions of the forest. With the demise of beaver, loss of their dams and subsequent lowering of the water table, plus heavy cattle grazing, many of these areas have become drier, and tree invasion is occurring. On others, fire exclusion has resulted in significant amounts of "rough" accumulating, which has affected plant growth. Noxious weeds are a problem on portions of the area, particularly where grazed by cattle.

Mountain grasslands -

These communities occupy sites within the normal forest environment where limited moisture precludes tree growth. They are commonly found on southerly aspects with shallow soils and are characterized by an area occupied by a grass community

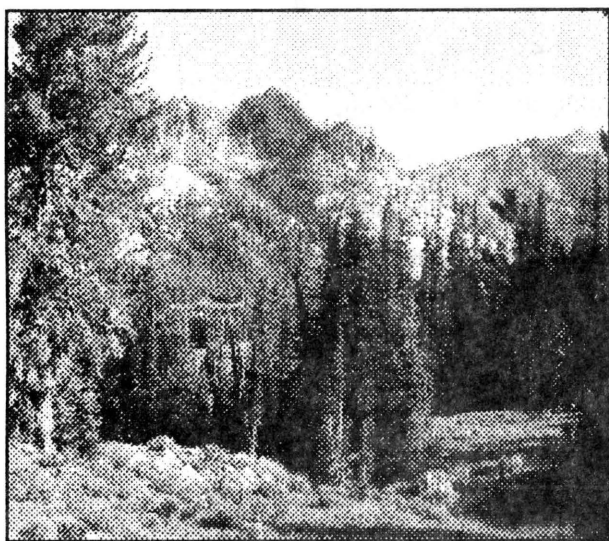


Photo: Historically, fire helps create meadows and grasslands - USFS

surrounded by a tension zone of varying size where graminoids or grass-like plants are maintained by periodic fire. This tension zone can support trees, but establishment is difficult and long term. Under normal fire frequencies, only scattered individuals become established. The community also occurs at the lower limits of tree growth on the forest.

A systematic mapping of these sites has not been undertaken to date. However, three types (Agsp/Posan, Fesc/Agsp and Fesc/Feid) probably represent the major communities. Areas of Feid/Agsp may also be present.

These types commonly have a wide variety of graminoids and forbs present along with some shrubs. Noxious weeds are a serious problem on portions of the community generally following roading or cattle grazing.

Fire normally occurred in conjunction with burns in adjacent forest types particularly on the low elevation sites. Normally, these sites are not large enough to warrant individual treatment and may be included in the plans for the timber community that surrounds them since natural fires occurred in this manner.

Mountain brush, Snow chutes and Alder glades -

This site represents a shrub community dominated by alder and other moisture loving species. The site is generally too wet or disturbed periodically by snow movement to permit conifer growth. Generally, these sites burn infrequently, but with proper conditions will burn intensely. Fire may help maintain these dense thickets of alder, but since they are normally small, treatment should be conducted in conjunction with the surrounding timber stand.

Habitat Group 1 - Warm and Dry

This group consists of the warm, droughty, open-grown, park-like stands of ponderosa pine and/or Douglas-fir with bunchgrass understories. Most of the sites occur at lower elevations.

Habitat Group 1		(52,754 Total acres on the Forest)	
<u>Habitat Type</u>	<u>Common Name</u>	<u>% of H.G.</u>	<u>Fire Group</u>
Pipo/Agsp	PP/wheatgrass	1.3%	2
Pipo/Syal	PP/snowberry	1.3%	2
Psme/Agsp	DF/wheatgrass	0.3%	4
Psme/Feid	DF/Idaho fescue	0.3%	5
Psme/Fesc	DF/rough fescue	73.9%	4
Psme/Syal-Agsp	DF/snowberry-wheatgrass	2.7%	4
Psme/Caru-Agsp	DF/pinegrass-wheatgrass	20.5%	4

Common Name Key: PP = Ponderosa Pine; DF = Douglas-fir

A natural fire-free interval of 5 to 25 years for underburning on these sites maintained grassy and open, park-like stands dominated by large and old ponderosa pine and some Douglas-fir. Stand replacement fires were probably rare at an interval of greater than 1,000 years.

Fire exclusion and logging of dominant trees from many of these sites over the last 100 years has changed most of their natural vegetation composition and structure. Currently, many are dominated by a denser and somewhat storied structure with a high composition of Douglas-fir. Currently, if wildfire enters these stands of changed vegetation patterns, it has a much greater potential to become a stand replacement fire rather than a low intensity underburn.

Fire Group 2 Based on tree species response to fire and its role in forest succession.

Warm, dry ponderosa pine habitat types. Open stands with grass undergrowth. May exist as fire-maintained grasslands. Supports only accidental Douglas-fir.

Fire Group 4

Warm, dry Douglas-fir habitat types. Exist as fire-maintained ponderosa pine stands that develop Douglas-fir regeneration beneath pine in absence of disturbance.

Fire Group 5

Cool, dry Douglas-fir habitat types. Often Douglas-fir is the only conifer on site. In absence of fire, dense Douglas-fir sampling understories may develop.

Site productivity potential for timber growth is low. Potential productivity for winter range is high. The predominance of higher density stands dominated by Douglas-fir has resulted in loss of forage producing species, and a loss of wildlife habitat for those species requiring an open ponderosa pine park-like habitat.

The ponderosa (Pipo series) types are in Fire Group 2 and represent the warmest and driest types on the forest. Fire will maintain portions of this type in grassland or open

pine savannas. Fuel loading under natural situations are about 1 ton per acre but may reach 16 tons per acre in younger stands.

The Douglas-fir (Psme series) types are in Fire Group 4, and although Douglas-fir may be present, ponderosa pine will dominate. Fuel loadings average about 11 tons per acre (2 to 30 tons per acre).

The Douglas-fir/Idaho Fescue (Psme/Feid) type is in Fire Group 5. It differs from other types listed above because of the dominance of Douglas-fir on these sites even with periodic natural burning. These sites are apparently too cool for ponderosa pine.

Shrub response in this group is low to moderate with chokecherry and serviceberry the principal forage species. Ceanothus response is generally low.

Habitat Group 2- Moderately Warm and Dry

These habitat types were characterized in naturally functioning ecosystem by open-grown stands of ponderosa pine or Douglas-fir with grass and brush understories. Most of the sites normally occur at lower elevations on many aspects, but are also found at higher elevations on more southerly and westerly aspects.

Habitat Group 2		(390,033 Total acres on the Forest)	
<u>Habitat Type</u>	<u>Common Name</u>	<u>% of HG.</u>	<u>Fire Group</u>
Psme/Vaca	DF/dwarf huckleberry	5.1%	6
Psme/Phma	DF/ninebark	84.7%	6
Psme/Syal	DF/snowberry	8.5%	6
Psme/Caru-Aruv	DF/pinegrass-kinnickinnick	2.6%	6
Psme/Arco	DF/arnica	0.1%	-
Psme/Spbe	DF/spiraea	T	4
Psme/Aruv	DF/kinnickinnick	T	-

Common Name Key: DF = Douglas-fir

The natural fire-free interval for underburning was 5 to 50 years. Little information is available for stand replacement fires, but the fire-free interval probably exceeded 500 years on the drier types and dropped to less than 200 years on the more moist types. This maintained, most commonly, open park-like stands dominated by ponderosa pine. In some cases, stand composition was high in Douglas-fir and western larch.

Fire Group 4

Based on tree species response to fire and its role in forest succession.

Warm, dry Douglas-fir habitat types. Exist as fire-maintained ponderosa pine stands that develop Douglas-fir regeneration beneath pine in absence of disturbance.

Fire Group 6

Moist Douglas-fir habitat types. Supports substantial amounts of Douglas-fir even when subjected to periodic fire.

Fire exclusion and logging of dominant trees from many of these sites over the last 60 years has changed the vegetation composition and structure on most of these sites. Currently, many are dominated by dense, storied structures with a high composition of Douglas-fir. Wildfire in these changed vegetation patterns would become a stand replacement fire rather than a low intensity burn.

Site productivity potential for timber growth is low. Potential productivity for winter range is high. The dominance by higher density stands dominated by Douglas-fir has resulted in loss in the productivity of high quality ponderosa pine, a loss of forage production species, and a loss of wildlife habitat for those species requiring open ponderosa pine park-like habitat.

Even within these habitat groups some significant environmental differences can occur. For example, the *vaccinium caespitosum* habitat type is indicative of frosty areas or frost pockets. These frosts can limit the development and growth of all but frost hardy species such as lodgepole or ponderosa pine.

The warm dry portions of Habitat Group Two are included in Fire Group 4. Fuel loading averages from 6 to 20 tons per acre. These types will generally contain more Douglas-fir, and fuel loading is normally heavier than Habitat Group 1.

Timber harvesting and/or burning will result in increases in intolerant shrubs such as serviceberry, ceanothus, willow, and chokecherry, peaking about 20 to 50 years after the disturbance. Shrub response is moderate to high and the group provides one of the best sites for shrub forage production. As the intolerant shrubs decrease, the more tolerant shrubs such as ninebark will regain their former coverage. The amount of pinegrass and sedges generally decreases after regeneration cutting with increases in bluebunch wheatgrass.

The moist phase types are in Fire Group 6 and represent one of the most important areas in need of fire on the forest. Under natural conditions the fire return period averaged 28 years with a range of 5 to 67 years. With the absence of fire, fuel loadings quickly build up providing the opportunity for stand-replacing fires. Fuel loadings may reach 75 tons per acre and probably average 12 to 40 tons per acre. Conversion of the community to almost pure Douglas-fir will likely occur in about 150 years with continued fire protection.

With cutting and/or burning the shrub layer will respond similarly to the dry phase but with significantly less development of the intolerant shrubs. Pine grass will usually maintain or increase its position. Understory vegetation should return to predisturbance conditions more quickly than in the dry phase.

Habitat Group 3 - Moderately Cool and Dry

These habitat types were characterized in naturally functioning ecosystems by mixed species stands of ponderosa pine, Douglas-fir, western larch and lodgepole pine. Understories in absence of fire or other disturbance, are composed primarily of dense Douglas-fir thickets, though other tree species may be present. Shrubs such as ninebark and snowberry and grasses such as pinegrass are very common on most sites. These sites are found on all sites on the Lolo, but especially on southeasterly, southern and western aspects.

Habitat Group 3		(325,496 Total acres on the Forest)	
<u>Habitat Type</u>	<u>Common Name</u>	<u>% of H.G.</u>	<u>Fire Group</u>
Psme/Vagl	DF/huckleberry	67.5%	6
Psme/Libo	DF/twinflower	2.4%	6
Psme/Caru	DF/pinegrass	29.3%	6
Psme/Cage	DF/elk sedge	0.8%	5
Psme/Juco	DF/juniper	T	-

Common Name Key: DF = Douglas-fir

The natural fire-free interval for underburning was 15 to 50 years. Little information is available for stand replacement fires, but the fire-free interval probably exceeded 500 years on the drier types and to less than 200 years on the more moist types. This maintained, most commonly, open park-like stands dominated by ponderosa pine, western larch and Douglas-fir. In some cases, stand composition was high in Douglas-fir and western larch.

Fire exclusion and logging of dominant trees from many of these sites over the last 60 years has changed the vegetation composition and structure on most of these sites. Currently, many are dominated by dense storied structures of a high composition of Douglas-fir. Wildfire in these changed vegetation patterns would now become a stand replacement fire rather than a low intensity burn.

Site productivity potential for timber growth is moderate. Potential productivity for winter range is high. The dominance of higher density stands dominated by Douglas-fir has resulted in a loss in the productivity of high quality ponderosa pine, the loss of forage production species, and a loss of wildlife habitat for those species requiring more open, park-like habitat.

Fire Group 5

Based on tree species response to fire and its role in forest succession.

Cool, dry Douglas-fir habitat types. Often Douglas-fir is the only conifer on site. In absence of fire, dense Douglas-fir sampling understories may develop.

Fire Group 6

Moist Douglas-fir habitat types. Supports substantial amounts of Douglas-fir even when subjected to periodic fire.

Habitat Group 3 is in Fire Group 6, with the exception of the Douglas-fir/elk sedge (Psme/Cage) type, which is in 5.

Understories are generally open, with huckleberry and pinegrass dominating the community. Fire protection has produced dense thickets of Douglas-fir reproduction and continued protection may result in the conversion to pure Douglas-fir in about 200 years. Fuel loadings are similar to the moist phase of Habitat Group 2.

Huckleberry can be stimulated by light burning that leaves most of the duff, or it can be reduced by a moderate fire that burns down to mineral soil. Pinegrass and sedges increase significantly with disturbance. As a new stand becomes established, huckleberry and beargrass revert to their former position with a corresponding drop in the graminoids. This cycle occurs in 20 to 50 years. The seral shrubs, serviceberry and ceanothus, have low to moderate response to disturbance but winter snow depths may preclude use by wildlife.

Habitat Group 4A - Warm and Moist

These are warm and moist habitats occurring along the lower slopes and valley bottoms. Nearly all the conifer species found on the Lolo can occur on these types. Understory vegetation may be dominated by a wide variety of species. These types produce the highest timber productivity on the Lolo. They are also very productive for wildlife due to the wide range of succession and plant species that occur on these sites.

Habitat Group 4A		(568,877 Total Habitat Group 4 acres on the Forest)	
<u>Habitat Type</u>	<u>Common Name</u>	<u>% of H.G.</u>	<u>Fire Group</u>
Abgr/Clun	GF/beadlily	11.6%	11
Thpl/Clun	WRC/beadlily	14.4%	11
Tshe/Clun	WH/beadlily	T	11

Common Name Key: GF = Grand Fir; WRC = Western Red Cedar; WH - Western Hemlock

Fire-free interval is wide from 50 years on the drier types to over 200 years on the more moist types. Typical fires are minor ground fires that create a mosaic within the stand. At the other extreme, with drying, a complete stand replacement fire will occur. This is usually the result of a fire burning from an adjacent and drier type.

Fire Group 11 Based on tree species response to fire and its role in forest succession.

Warm, moist habitat types. Occurs on valley bottoms, benches, ravines, and protected exposures. Fires are infrequent and often severe. Grand fir habitats are the driest in this group.

Fire exclusion on these sites has changed them very little except to reduce the number of acres in early succession types. Many species do well on these sites and may thrive for centuries without disturbance. Western red cedar is the most notable example.

Habitat Group 4B - Cool And Moist

These are generally cool and very moist sites. they contain many species, but are generally too cold for western red cedar and western hemlock. Common conifers include Douglas-fir, Engelmann spruce, grand fir, lodgepole pine, mountain hemlock, western larch and western white pine. Abundant understory species are present especially moist favoring species such as queen's cup beadlily, baneberry, twinflower, menziesia and redosier dogwood.

Habitat Group 4B		(568,877 Total Habitat Group 4 acres on the Forest)	
<u>Habitat Type</u>	<u>Common Name</u>	<u>% of H.G.</u>	<u>Fire Group</u>
Picea/Libo	S/twinflower	0.1%	7
Abla/Clun	AF/beadlily	17.7%	9
Abla/Gatr	AF/bedstraw	0.9%	9
Abla/Libo	AF/twinflower	0.9%	9
Abla/Mefe	AF/menziesia	31.7%	9
Tsme/Mefe	MH/menziesia	0.2%	9

Common Name Key: S = Spruce; GF = Grand Fir; AF = Alpine Fir; MH - Mountain Hemlock

Average fire-free intervals range from 90 to 130 years. Many stands exist that have an interval exceeding 130 years.

The spruce/twinflower (Picea/Libo) type and portions of the alpine fir/twinflower (Abla/Libo) type are generally dominated by lodgepole pine and are in Fire Group 7. A discussion of this fire type will be included with Habitat Group 5. The other alpine fir types in Habitat Group 4A and the mountain hemlock type are in Fire Group 9 and have a low fire frequency.

Fire Group 7

Based on tree species response to fire and its role in forest succession.

Cool habitat types usually dominated by lodgepole pine. Includes stands in which fire maintains lodgepole pine as dominant seral as well as those in which it is a persistent dominant species.

Fire Group 9

Moist, lower subalpine habitat types. A collection of lower subalpine habitats in which fires are infrequent, but severe.

Fires that do occur are often severe and their effects may be long lasting. Fuel loadings vary from 1 to 80 tons per acre and average 30 tons.

The remaining habitat type in this group, mountain hemlock/menziesia (Tsme/Mefe) is included in Fire Group 11, which also has an infrequent and often severe fire cycle. Fuel loadings range from 15 to 40 tons per acre and average 25 tons.

Shrub understory -

The Abla/Mefe represents the major portion of this type and has significant amounts of shrubs present in all stages of community development. Only under the most dense

crowns does the shrub layer decrease to any degree. After timber harvest and/or burning, intolerant shrubs may increase slightly and tolerant shrubs will decrease significantly. These sites, however, have snow depths which preclude most winter use by wildlife. As the community develops, the amount of seral shrubs decrease in relation to the crown development of the new overstory. By the time the stand reaches pole size, tolerant shrubs have returned to predisturbance coverage.

Shrub-forb understory -

Under mature overstories, a few scattered shrubs and an occasional forb may comprise the understory component. After timber harvest and/or burning, forbs and shrubs will increase significantly, causing a dramatic change in species mix and numbers. As the new tree layer develops and provides shading, the understory vegetation will decrease in numbers and vigor, reverting to predisturbance conditions in about 10 to 50 years. Seral shrubs make up a significant portion of the initial community but they are quickly shaded out by the developing tree component. These sites can provide excellent forage for big game. However, it will be of short duration.

Habitat Group 4C - Very Wet

These are very wet sites. They are characteristic along streams and are associated with wetlands.

Habitat Group 4C		(568,877 Total Habitat Group 4 acres on the Forest)	
<u>Habitat Type</u>	<u>Common Name</u>	<u>% of H.G.</u>	<u>Fire Group</u>
Picea/Gatr	S/bestraw	T	9
Thpl/Opho	WRC/devil's club	0.2%	11
Abla/Opho	AF/devil's club	T	9
Abla/Caca	AF/bluejoint	0	9

Common Name Key: S = Spruce; WRC = Western Red Cedar; AF = Alpine Fir

Due to this very wet condition, the fire-free interval can be long. Intervals are probably much longer than the majority of Fire Group 9, 90 to 130 years, and are probably in excess of 150 years.

The alpine fir types in Habitat Group 4C are in Fire Group 9 and have a low fire frequency. Fires that do occur are often severe and their effects may be long lasting. Fuel loadings vary from 1 to 80 tons per acre and average 30 tons.

Fire Group 9 Based on tree species response to fire and its role in forest succession.

Moist, lower subalpine habitat types. A collection of lower subalpine habitats in which fires are infrequent, but severe, with long-lasting effects.

Fire Group 11

Warm, moist habitat types. Occurs on valley bottoms, benches, ravines, and protected exposures. Fires are infrequent and often severe. Grand fir habitats are the driest in this group.

The mountain hemlock/menziesia (Tsme/Mefe) and the western red cedar (Thpl/Opho) types are included in Fire Group 11, which also has an infrequent and often severe fire cycle. Fuel loadings range from 15 to 40 tons per acre and average 25 tons.

Habitat Group 4D - Moderately Cool and Somewhat Moist

These are the dry and cool grand fir environments of Habitat Group 4.

Habitat Group 4D		(568,877 Total Habitat Group 4 acres on the Forest)	
<u>Habitat Type</u>	<u>Common Name</u>	<u>% of H.G.</u>	<u>Fire Group</u>
Psme/Libo	DF/twinflower	%	6
Abgr/Xete	GF/ beargrass	21.5%	6
Abgr/Libo	GF/twinflower	%	11

Common Name Key: DF = Douglas-fir; GF = Grand Fir

The fire free interval is 15-40 years on the drier Douglas-fir sites and from 50-150 years on the cooler and moister sites of the grand fir series. Fuel loading is highly variable due to the wide range of intervals and supported forest types. Lodgepole pine and Douglas-fir are most common, but ponderosa pine and western larch can become long-lived dominants. Stands tend to be overstocked. Natural thinning commonly sustains fuel loadings of 15 to 50 tons.

Fire Group 6 Based on tree species response to fire and its role in forest succession.

Moist Douglas-fir habitat types. Supports substantial amounts of Douglas-fir even when subjected to periodic fire.

Fire Group 11

Warm, moist habitat types. Occurs on valley bottoms, benches, ravines, and protected exposures. Fires are infrequent and often severe. Grand fir habitats are the driest in this group.

Habitat Group 5 - Cool and Moderately Dry

These are the cooler subalpine fir habitat types on the Forest.

Habitat Group 5		(396,806 Total acres on the Forest)	
<u>Habitat Type</u>	<u>Common Name</u>	<u>% of H.G.</u>	<u>Fire Group</u>
Abla/Vaca	AF/dwarf huckleberry	0.5%	7
Abla/Xete	AF/beargrass	98.%	7&8
Abla/Caru	AF/pinegrass	0.7%	-
Tsme/Xete	MH/beargrass	0.6%	8
Abla/Vagl	AF/huckleberry	0.2%	7

Common Name Key: AF = Alpine Fir; MH = Mountain Hemlock

The fire-free interval of these types is 50-130 years. Periodic fire disturbance favors species such as lodgepole pine, Douglas-fir and western larch. Other species on these sites are commonly subalpine fir, spruce and whitebark pine. These sites are quite frosty, especially in the dwarf huckleberry (*Vaccinium caespitosum*) and grouse whortleberry (*scorparium*) types.

Burns in these habitat types often follow heavy mortality in lodgepole pine from mountain pine beetle. Management of these stands on a long term basis must recognize the role that mountain pine beetle plays in these communities. A major infestation can be expected when the community is around 100 years of age (70-150).

These sites historically had light underburns on a fairly regular basis and a stand replacement fire associated with fuel buildups from mountain pine beetle epidemics. Fuel loadings range from 3.5 tons per acre to 35 tons, and average 20 tons.

Steve Arno, of the USFS Intermountain Fire Sciences Lab, and others, in work done in 1985, divides the alpine fir/beargrass (Abla/Xete) type into warm and cold phases that are described below. The alpine fir/beargrass and huckleberry (Abla/Xete-Vagl) and the mountain hemlock/beargrass (Tsme/Xete) types are in Fire Group 8 (which is similar to group 9 and described above). The remainder are in Group 7.

Warm phase (Fire Group 8)

Most natural communities are dominated by Douglas-fir and lodgepole pine, with some western larch. Understories vary according to the frequency and intensity of past fire. Communities are generally open with scattered patches of subalpine fir reproduction. Huckleberry and beargrass dominate the shrub layer.

With fire protection, the amount of subalpine fir increases substantially in the understory.

Cold phase (Fire Group 7)

Natural communities are dominated by fire-maintained lodgepole pine. Subalpine fir may be a major component of the understory, but generally does not achieve dominance because of frequent fires.

With fire protection, these sites could be dominated by subalpine fir in about 200 years. Understory vegetation is similar to that in the warm phase except for increased amounts of grouse whortleberry.

After treatment, changes similar to those in the warm phase can be expected; however, seral shrubs will show limited response. Recovery and tree growth is slower than in the warm phase.

Fire Group 7 Based on tree species response to fire and its role in forest succession.

Cool habitat types usually dominated by lodgepole pine. Includes stands in which fire maintains lodgepole pine as dominant seral as well as those in which it is a persistent dominant species.

Fire Group 8

Dry, lower subalpine habitat types. Primarily an eastern Montana group although it is represented on the Lolo.

Habitat Group 6 - Cold

This group represents high elevation cold sites. Many are above the cold limits of Douglas-fir. Common species are whitebark pine, lodgepole pine, mountain hemlock, subalpine fir and alpine larch.

Habitat Group 6		(127,746 Total acres on the Forest)	
<u>Habitat Type</u>	<u>Common Name</u>	<u>% of H.G.</u>	<u>Fire Group</u>
Abla/Vasc	AF/whortleberry	2.3%	-
Abla (Pial)/Vasc	AF/(WBP)/whortleberry	14.4%	-
Abla/Luhi	AF/woodrush	80.5%	10
Pial-Abla	WBP-AF	1.8%	10
Laly-Abla	AL-AF	0.7%	10
Pial	WBP	0.7%	10

Common Name Key: AF = Alpine Fir; WBP = Whitebark Pine; AL - Alpine Larch

The fire-free interval varies considerably from 35 to 300 years. Stand replacement fires occur after intervals of more than 200 years.

The major type is alpine fir (Abla/Luhi) and alpine woods rush. Tree communities in this group vary from closed stands

of Engelmann spruce, subalpine fir, lodgepole pine or whitebark pine to open-grown, stunted individuals of whitebark pine, subalpine fir, alpine larch or Engelmann spruce. Under natural conditions, infrequent, low-intensity fires generally burned into the group from lower elevations. Once burned, recovery is slow, with regeneration taking up to several decades.

Fuel loadings are highly variable and fire suppression policies have had little impact on fire frequency or fuel loadings. Communities will continue to advance toward latter successional stages, but this process will require up to two or three centuries.

Fire Group 10 Based on tree species response to fire and its role in forest succession.

Cold, moist subalpine and timberline habitat types. High elevation habitats in which fires are infrequent. Small area fires are common because of fuel. Severe fires have long-term effects.

The above is from J. Losensky's 1984 report *An Assessment of Fire Effects on Lolo National Forest Ecosystems*.

-- See Appendix E for fire techniques recommended for use in Habitat Groups 0 and 5.

We talk about resource management
as a way of sustaining the productivity of the land,
but what if we talked about sustaining the *generosity*
of the land? Turn that around in your mind a few times.
Try to get a feel for what it would be like to think about the
land in terms of its generosity instead of its productivity.
Or what if we thought in terms of sustaining the *creativity*
of the land? As another example, look at the word
"management" - basically it means to handle or control.
What if, instead of talking about managing an ecosystem,
we spoke of *cooperating* with the ecosystem?
Or how about *participating* in the ecosystem?

-- Herb Schroeder,
USFS Scientist

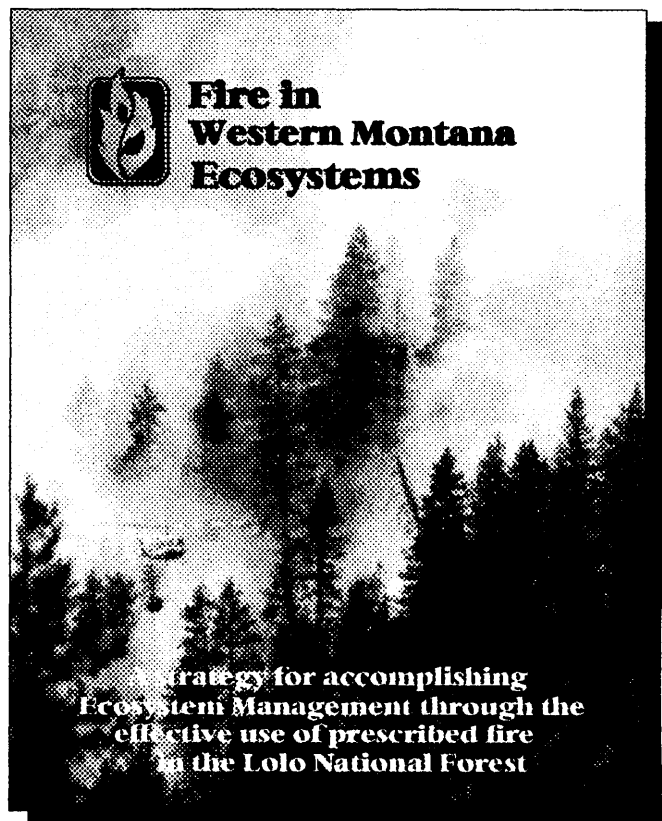
PROGRAM EVALUATION AND PRIORITIZATION

This document, supported by many others, determines that the Lolo National Forest contains fire-dependent ecosystems. If these systems are to sustain their natural, healthy balance of species, they need the periodic presence of fire. For decades, Lolo Forest land managers have *prescribed* fire for certain areas of the Forest: to enhance wildlife forage, to prepare sites for planting, and to reduce fire hazards on those sites. Ecosystem maintenance research shows more regularly scheduled applications of fire are needed. The following is an updated and expanded maintenance prescribed burning program now called the Ecosystem Fire Program. It will provide specific details on the management areas needing attention, the acreages involved by ranger district, and the overall costs for each level of fire program implementation.

It was in the mid-1980's that an interdisciplinary team of Lolo Forest staff reviewed the forest with a goal of understanding each management area objective and the natural role that fire played in its habitat types. From this review, the team created guidelines for the original Ecosystem Management Burning (EMB) program, which was implemented in 1987. Still valid today, these guidelines, which assume that the average fire-return frequency found under natural conditions represents the optimum frequency of return for ecosystem balance, have been adopted into this report.

Also still valid for this report is the original consideration of funding. As the creators of the 1987 burning program recognized, the optimum level of fire in the ecosystem is a considerable amount when compared to today's level. That's why this new program calls for a five-step approach to full implementation. Until the Lolo can commit to a program for total ecosystem burning, there must be some prioritization of management areas (MA) and habitat groups (HG). This will insure those MA-HG combinations with the highest priority for attention will receive it, which will also ensure the best return for the dollar invested.

To determine the relative importance of treatment of one MA-HG over another, planners used the Tradeoff Evaluation Procedure (see Appendix F). Seven factors,



including ecosystem balance and wildlife concerns, treatment need and effectiveness, cost per acre and economic return, were used as the basis of the evaluation procedure. These factors, described fully on page 84, were determined by reviewing Forest Plan goals as well as the objectives of the ecosystem burning program. Finally, the MA-HG combinations were evaluated against a series of fire treatment levels.

The original study found that about 12,000 acres a year needed treatment to fully implement an ecosystem burning program. However--because of a number of factors, primarily funding--it was thought that a treatment target of 6,000 acres would suffice. This report, in light of the call for total ecosystem management and the five-year Forest Plan review, recommends that the optimum level of 12,000 acres now be targeted. Yet, reaching this level of treatment still means gradual program implementation. Accordingly, the findings of the original analysis are still important.

Ecosystem Fire Program Levels

Level 1 -

Represents treating only the high value areas on the forest, as well as only minimal treatment of wildlife habitat.

Level 2 -

Represents the current minimal level of burning on the forest. Some problems in respect to community balance may be encountered. Other benefits will be significantly less than Level 3.

Level 3 -

Represents what is presently considered the optimum frequency of fire application for ecosystem balance.

--Analysis is presented in Appendix F along with an explanation of how it was conducted.

The rankings of each MA-HG combination and their score for each fire treatment level are found in Appendix F. This ranking system identified two MA-HG combinations (19-2 and 9-2) as being the highest value areas on the Forest. (They were identified by subtracting the lowest EMB score, which was 136, from the highest score, 329. This resulted in a spread in the scores of 193. Using 10 percent of this spread, MA-HG combinations with a score greater than 310 were considered high value.) Treating these two MA-HG's would result in an annual burning program of 1,200 acres.

Including all the combinations that scored in the top third of the EMB score, a second implementation level was determined. In addition to the two high priority MA-HG's, this group represents a total of 3,200 acres to be treated on an annual basis. Currently, this is the minimal level of ecosystem burning on the Lolo National Forest.

Level 3 would treat the optimum 12,000 acres. However, since the time and money involved in achieving this level of treatment prohibits immediate implementation, we are recommending a five step approach to reaching the optimum level. Consequently, between Level 3 and Level 5, there would be interim treatments. In Fiscal Year 96, there is a target of 6,000 acres. In FY 97 the goal is to treat 10,000 acres.

Prescribed Fire Program Implementation Levels

LEVEL

1

1200 Acres

This program level would treat the high value (priority 1) areas. An annual program of 1,200 acres would be undertaken at a cost of \$40,000. This would be roughly one-third of the current program.

.....

Level 1 would provide a minimal acreage of treatment on big game winter range. Over time about 33 percent of Management Area (MA) 19 would be treated. No treatment would be scheduled on MA's 18, 22 and 23, except as would occur during timber harvest.

Forest plan outputs for winter range forage may not be met by this alternative. Major dispersed recreation sites would be kept in a vegetatively healthy condition with about 50 percent of the MA treated. It would provide the public a moderately diverse visual experience with a high expectancy of observing various wildlife species.

Treatment of Habitat Group (HG) 2 for ecosystem balance would be relatively high with 67 percent of the proposed acres treated; however, none of the other groups would receive treatment. Improvements in growth from nutrient cycling and reduction of insect and disease losses on regulated acres would not be achieved.

No treatment would be accomplished for threatened and endangered species or old growth species.

Acres by District and MA-HG Combination

for Proposed Ecosystem Fire Program

MA - HG		DISTRICT					TOTAL
		Missoula	Ninemile	Plains	Seeley Lake	Superior	
19	2	21	353	432	0	100	906
9	2	194	6	1	33	0	234
Total		215	359	433	33	100	1200

LEVEL**2****3200 Acres**

Under this program level 3,200 acres would be treated at a cost of \$100,000. The acreage amount of this option has generally been implemented on the Lolo since 1987, when the original Ecosystem Maintenance Burning program was approved.

.....

Over the next 30 years 98 percent of MA 19 would be treated and 33 percent of MA's 18, 22 and 23. A major portion of the untreated acres in MA's 18, 22 and 23 are in HG 1, which are dry grass types having a minor response to burning. It's anticipated that forage outputs for big-game can be met by this program level. However, there could be a minor impact on bighorn sheep because portions of their range are untreated.

Major dispersed recreation sites would be similar to Level 1, except that slightly more acreage would be treated (52 percent). In addition, HG 2 would be treated in the roadless areas (MA11) on the forest, increasing natural diversity and value for recreation and providing additional forage for wildlife. About 63 percent of the threatened and endangered acreage in MA 20 would be treated.

A significant portion of HG-2 will be treated (89 percent) with a portion of the untreated acreage being in the regulated portion of the Forest, which will be treated to some degree when the stands are regenerated. This will provide a moderately high level of ecosystem balance. Some gains in growth will be achieved on a portion of the regulated winter range acres. This represents about 19 percent of the proposed acres to be treated. No treatment will occur on sites for old-growth species. (See Appendix F for support information.)

Acres by District and MA-HG Combination

for Proposed Ecosystem Fire Program

MA - HG		DISTRICT					TOTAL
		Missoula	Ninemile	Plains	Seeley Lake	Superior	
19	2	21	353	432	0	100	906
9	2-5	194	6	1	33	0	234
18-22							
23	2 1/	31	70	44	3	112	260
19	4*	0	1	11	0	6	18
11-28	2	59	33	20	15	62	189
19	1	178	130	64	0	185	557
20	4* 2/	0	0	9	6	0	15
20	2 2/	0	0	22	27	0	49
19	0	233	17	341	0	118	709
19	3	5	85	103	0	16	209
18	4*	0	3	3	0	4	10
19	4	0	1	6	0	2	9
Total		721	699	1056	84	605	3200

* Represents the GF/Xete portion of Habitat Group (21.5%) which will be treated the same as HG 3.

LEVEL**3****12,000 Acres**

To fully implement the Ecosystem Fire Program requires the treatment of 12,000 acres a year at a cost of \$800,000. Even with adequate financing, limitations on available burning days with proper conditions may restrict the acres that can be treated. The 12,000 acres represents treatment of all acres at the optimum burning frequency level (Level 3). (See Appendix F.)

Acres by District and MA-HG Combination

for Proposed Ecosystem Fire Program

MA - HG		DISTRICT					TOTAL
		Missoula	Ninemile	Plains	Seeley Lake	Superior	
19	2	31	529	649	0	150	1359
19	3	5	85	103	0	16	209
19	4	0	1	11	0	6	18
19	1	522	378	188	0	543	1631
18							
22-23	2	31	70	44	3	112	260
19	5	0	4	10	0	4	18
20A	2	0	0	42	0	0	42
9	2	194	6	1	33	0	234
19	0	271	20	398	0	138	827
28	2	34	0	0	0	0	34
11	2	29	38	24	17	73	181
19	4	0	1	6	0	2	9
20	2	0	0	45	53	0	98
16-17							
24-25	2	413	442	355	204	352	1766
21	2	0	0	0	0	0	0
26	2	0	0	0	0	0	0
18							
22-23	3	24	57	76	10	82	249
18							
22-23	4*	0	3	3	0	4	10
20A	3	0	0	18	0	0	18
20A	4*	0	0	7	6	0	13
18							
22-23	1	232	441	126	0	273	1072
9	3	42	0	0	17	0	59
9	4*	0	0	1	0	7	8
18							

continued on next page

Level 3 Continued

Acres by District and MA-HG Combination for Proposed Ecosystem Fire Program

MA - HG		DISTRICT					TOTAL
		Missoula	Ninemile	Plains	Seeley Lake	Superior	
22-23	5	0	0	0	0	0	0
28	3	26	0	0	0	0	26
11	3	70	50	14	17	33	184
28	4*	6	0	0	0	0	6
11	4*	13	15	25	8	16	77
9	1	78	15	5	0	0	98
20A	5	0	0	17	15	0	32
28	1	7	0	0	0	0	7
11	1	13	2	0	2	2	19
20	3	0	0	43	31	0	74
20	4*	0	0	18	12	0	30
9	5	2	0	0	2	17	21
16-17							
24-25	3	645	416	690	205	360	2316
16-17							
24-25	4*	23	50	125	15	166	379
10	3	0	0	8	0	0	8
10	4*	0	2	2	0	0	4
20A	0	0	0	44	8	0	52
1	3	0	0	0	0	0	0
28	5	12	0	0	0	0	12
11	5	39	45	48	31	18	181
16-17							
24-25	1	0	0	0	0	0	0
9	0	91	13	0	20	92	216
21	3	0	0	0	0	0	0
10	1	17	0	15	0	0	32
26	3	0	0	0	0	0	0
28	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
18							
22-23	4	0	0	0	0	0	0
20	5	0	0	0	0	0	0

continued on next page

Level 3 Continued

Acres by District and MA-HG Combination for Proposed Ecosystem Fire Program

MA - HG	DISTRICT					TOTAL
	Missoula	Ninemile	Plains	Seeley Lake	Superior	
24-25 5	0	0	0	0	0	0
21 1	27	14	0	0	0	41
10 5	0	4	1	0	0	5
20A 4*	0	0	9	7	0	16
TOTAL	2897	2701	3171	716	2466	12000

*Represents the GF/Xete of the Habitat Group (21.5) which will be treated the same as Habitat Group 3

"...**W**hat holds people together long enough
to discover their power as citizens
is their common inhabiting of a single place.



No matter how diverse and complex
the patterns of livelihood may be
that arise within a river system,
no matter how many the perspectives
from which people view the basin,
no matter how diversely they value it,
it is, finally,
one and the same river for everyone.

There are not many rivers,
one for each of us, but only this one river,
and if we all want to stay here,
in some kind of relation to the river,
then we have to learn, somehow to live together."

-- Daniel Kemmis
Community and the Politics of Place

IMPLEMENTING FIRE IN THE ECOSYSTEM

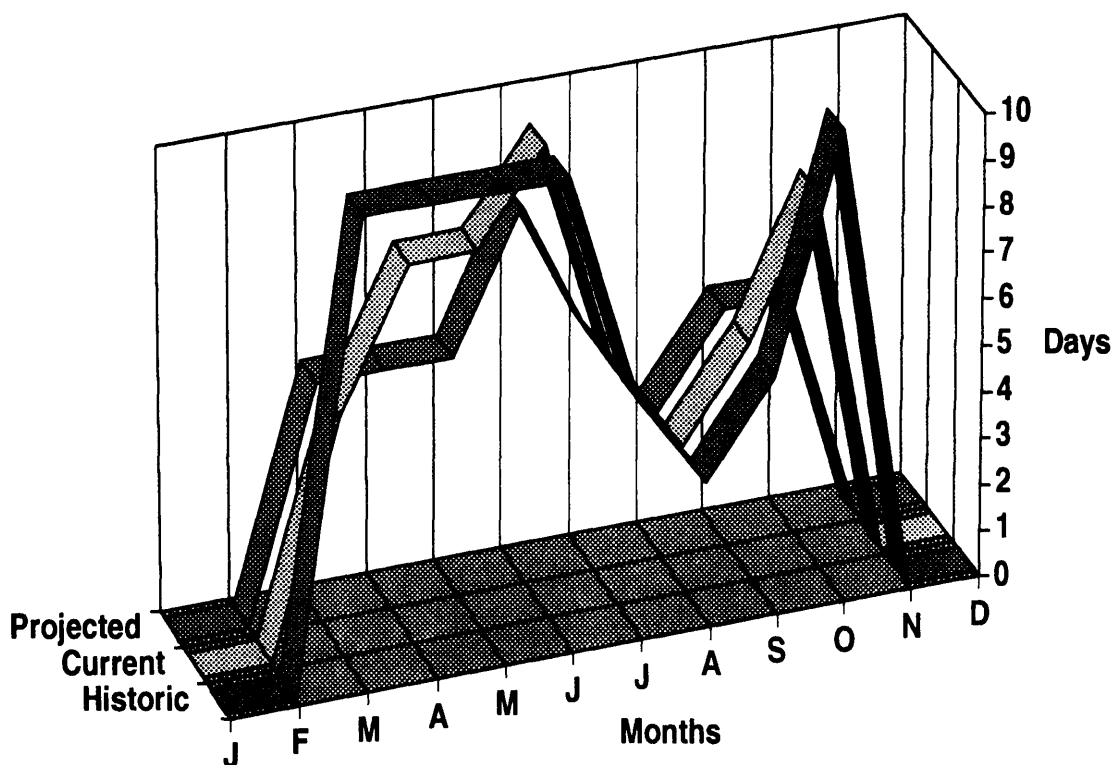
To the scientists, expanding the prescribed fire program seems a simple and biologically sound way to restore sustainable conditions and to help solve many sociological forest health problems in fire-adapted types. However, the use of prescribed fire—especially on a landscape scale—presents land managers with a serious dilemma: Although fire regulates the biotic productivity and stability of fire-adapted ecosystems in ways that cannot be fully emulated by mechanical or chemical means, the negative effects of smoke and the risk of consequences restrict its use.

Further compounding the dilemma is a caution against a rushed reintroduction of fire in long-needle pine types where high fuel loadings and multi-storied canopies have developed in the prolonged absence of fire. Under these conditions, chances increase that burning will exceed acceptable risk. Without intermediate understory treatments, managers will experience an unacceptably high number of escapes or will be forced to constrain burning windows to the extent that sizeable acreage cannot be treated.

Sustaining short interval fire-adapted ecosystems, in particular, is emerging as an important challenge. Although it's clear that treatment efforts will encounter significant problems, avoiding treatment is not without serious risks.

Air Quality/Smoke Management:

Through review of available burning days for the past, present and future, as well as field varification by Ranger Districts, this analysis concludes that the current level of available burning days will drop by approximately 20% over the next decade. However, fully implementing the Ecosystem Fire Program can still be done.



This document lays the foundation of the Ecosystem Fire Program. Lolo's Ranger Districts must build the framework. Accordingly, the following strategy is recommended:

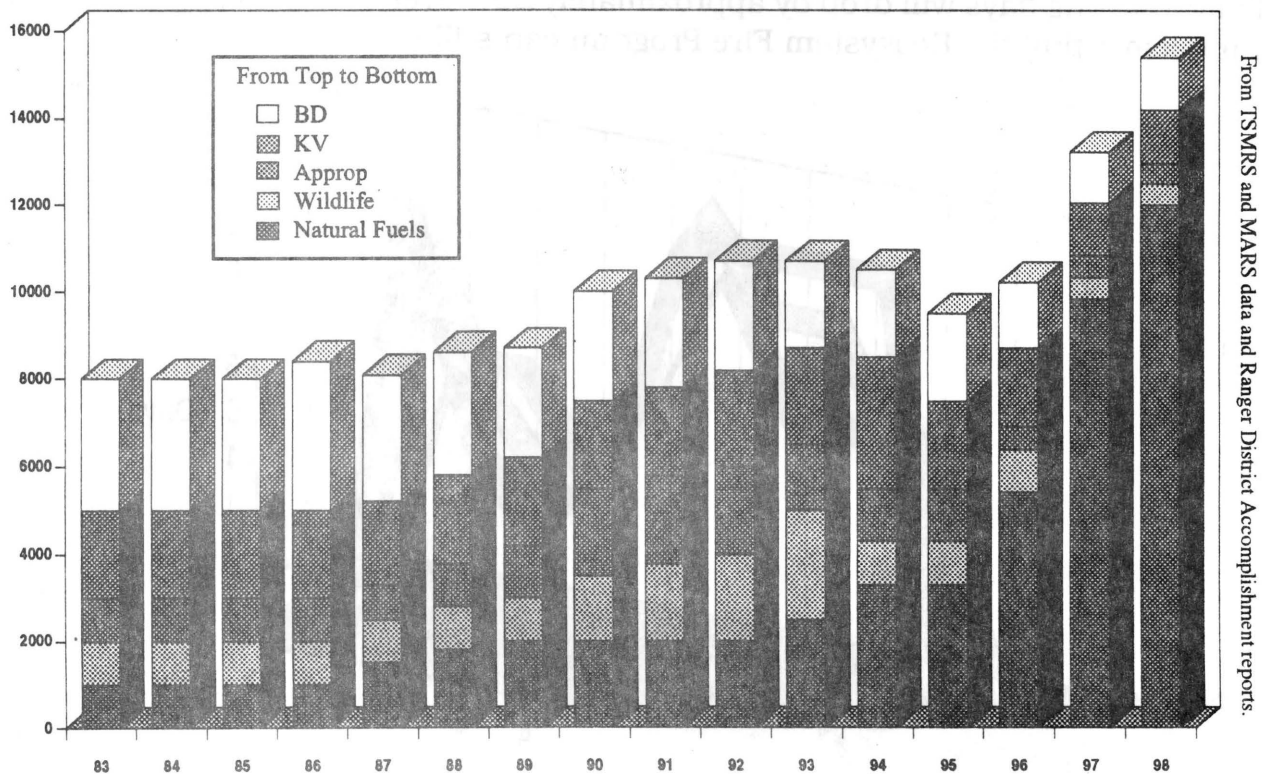
Strategy:

Beginning in FY94 , a stairstep program would be followed to fully implement the recommended ecosystem burning plan by FY98.

Proposed Ecosystem Fire Program by Year and Acreage				
FY94: 3,200 ac.	FY95: 4,000 ac.	FY96: 6,000 ac	FY97: 10,000 Ac	FY98: 12,000 ac

The advantage to stairstepping the Ecosystem Fire Program so that it's fully implemented by FY98 is that there will be no substantial increase in organizational needs or sociological impacts. The projected drop in timber activity burning on the Lolo will proportionately fall at the same period the Ecosystem Fire program is increasing. This means no substantial increase in smoke.

An important issue to consider in relationship to being able to fully implement the Ecosystem Fire Program is the total burning that the forest can accomplish. As with the air quality/smoke management issues, which reflect declining available burning days, the amount of slash treatment and site preparation burning will also decrease substantially due to Annual Sale Quota (ASQ) reduction. Currently, the Lolo is burning



6,000 to 8,000 acres per year with all types of burning. Approximately 6,000 acres per year are being burned through timber sale activity. By FY98, this will drop to 4,000 acres.

The Process:

This analysis provides the foundation for a program that effectively deals with fire and ecosystem management and implementing the Lolo Forest Plan. It provides a trackable and quantifiable program that is flexible, stable and cost effective. The key to implementation is district's building the framework for outyear implementation. Beginning in FY94 funding will be provided for outyear planning. The concept is that the current year program target will include the following two FY burning acreages as a target from a planning preparation standpoint. For example:

Missoula Ranger District - FY94:

Current year burning target: 721 acres

Planning for FY95/96 program: 1500 acres

(i.e. environmental assessment, decision notices, burning plans ready prior to FY 95)

Silvicultural Considerations

Although the fire situation now is widely recognized, its solution is elusive. It might seem plausible to let natural fire regimes return, especially in wilderness or other "natural areas." One problem is, however that even in large, natural areas, fires do not stay where they are welcome (illustrated by the 1988 fires in the Greater Yellowstone area). Instead, they spread into valuable timber stands having fuel accumulations, private lands, ranches, summer homes, and towns. Even in the fire-adapted ponderosa pine types, fuels often built up to such an extent that ancient trees, which survived many fires in past centuries, are now killed in modern fires. Because of fire exclusion and selective logging, modern fires also may not restore the historic seral vegetation types, such as ponderosa pine. Therefore, instead of simply returning to a philosophy of letting fires burn, it may be necessary to use restoration forestry involving silvicultural cutting of unwanted trees, prescribed burning for site preparation, and planting of desired species. (Bottom line, we will need to modify current unnatural stand conditions before fire can play its historic role.)

Prescribed fire and silvicultural treatment will have to be performed in landscape-sized efforts, if the conversion to more natural conditions is to work the same way as past natural disturbance processes. Reintroduction of periodic prescribed burning on a landscape scale could increase biological diversity, improve the vigor and vitality of plant communities, improve the availability of plant species palatable to ungulates, stimulate cone crops from seral species, decrease the invasion rate of exotic species, reestablish natural species mix, and reduce wildfire hazard.

The use of prescribed fire to accomplish stand-management objectives historically performed by fire helps ensure that any unknown roles of fire in the ecosystem will be preserved.... Can treatments other than fire duplicate fire's nutrient cycling, cleansing, and thermal roles and have less impact on the site and surrounding environment? In many cases, probably not.

The above is from *Forest Health in the Blue Mountains* by Robert Mutch, Stephen Arno, et. al.

Available Burning Days (Based on 1963-93 Figures)

for proposed Planning Program

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total**
Historic	0	0	10	15	25	20	10	10	5	10	0	0	63
Current	0	0	5	8	8	10	10	10	5	8	0	0	52
Projected:	0	0	5	5	5	5	5	5	5	5	0	0	41

The above information reflects the number of available burning days in a year. These figures are based on 1963-1993 historical weather data, fire quality records, and projected trends. The information below reflects the amount of monthly burning by district, based on the MA/HG combination, as shown on page 85 of this document.

'94 Acres:	0	0	500	721	699	84	1056	605	800	0	0	0	3200
*Missoula	0	0	115	131	231	43	180	0	180	0	0	0	721
*Ninemile	0	0	112	137	225	44	175	0	175	0	0	0	699
*Seeley	0	0	13	18	27	5	21	0	21	0	0	0	84
*Plains	0	0	169	225	296	51	264	0	264	0	0	0	1056
*Superior	0	0	97	137	151	20	151	0	151	0	0	0	605
'95 Acres:	0	0	500	1310	1310	84	1056	605	800	0	0	0	4000
*Missoula	0	0	115	131	231	43	180	0	180	0	0	0	721
*Ninemile	0	0	112	137	225	44	175	0	175	0	0	0	699
*Seeley	0	0	13	18	27	5	21	0	21	0	0	0	84
*Plains	0	0	169	225	296	51	264	0	264	0	0	0	1056
*Superior	0	0	97	137	151	20	151	0	151	0	0	0	605
'96 Acres:	0	0	500	1310	1310	84	1056	605	1520	0	0	0	6000
*Missoula	0	0	131	131	231	43	377	0	377	0	0	0	1348
*Ninemile	0	0	112	137	225	44	328	0	328	0	0	0	1173
*Seeley	0	0	13	18	27	5	165	0	165	0	0	0	374
*Plains	0	0	169	225	296	51	404	0	404	0	0	0	1444
*Superior	0	0	107	137	151	20	300	0	300	0	0	0	1073
'97 Acres:	0	0	500	1310	1310	84	1056	605	2000	1000	0	0	10000
*Missoula	0	0	131	131	231	43	437	0	437	0	0	0	2376
*Ninemile	0	0	112	137	225	44	411	0	411	0	0	0	2109
*Seeley	0	0	13	18	27	5	68	0	68	0	0	0	676
*Plains	0	0	169	225	296	51	270	0	270	0	0	0	2697
*Superior	0	0	107	137	151	20	198	0	198	0	0	0	1983
'98 Acres:	0	0	500	1310	1310	84	1056	605	2000	450	0	0	12000
*Missoula	0	0	131	131	231	43	492	116	492	116	0	0	2897
*Ninemile	0	0	112	137	225	44	459	108	459	108	0	0	2701
*Seeley	0	0	13	18	27	5	122	29	122	29	0	0	716
*Plains	0	0	169	225	296	51	539	127	539	127	0	0	3171
*Superior	0	0	107	137	151	20	419	99	419	99	0	0	2466

Key: ☐ Spring Burning ☒ Summer Burning ☐ Fall Burning

* Total acreage and Ranger Districts are rounded up to the nearest whole number.

Acreages & District Project Costs ¹

for Proposed Ecosystem Fire Program

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
'94 Acres:	0	0	500	665	1000	200	0	0	400	400	0	0	3200
Total Costs													\$100,000
*Missoula Acres	0	0	115	151	231	43	0	0	90	90	0	0	720
Costs	0	0	\$2300	\$3020	\$4620	\$2193	0	0	\$5490	\$5490	0	0	\$23,113
*Ninemile Acres	0	0	112	147	224	42	0	0	86	87	0	0	698
Costs	0	0	\$2240	\$2940	\$4480	\$840	0	0	\$5246	\$5246	0	0	\$20,992
*Seeley Acres	0	0	13	18	27	5	0	0	21	0	0	0	84
Costs	0	0	\$260	\$360	\$540	\$255	0	0	\$1281	0	0	0	\$2696
*Plains Acres	0	0	169	222	338	63	0	0	132	132	0	0	1056
Costs	0	0	\$3380	\$4440	\$6760	\$3213	0	0	\$8052	\$8052	0	0	\$33,897
*Superior Acres	0	0	97	127	194	36	0	0	76	75	0	0	605
Costs	0	0	\$1940	\$2540	\$3880	\$1836	0	0	\$4575	\$4575	0	0	\$19346
'95 Acres:	0	0	500	665	1000	200	0	0	400	400	0	0	4000
Total Costs													\$106,479
*Missoula Acres	0	0	115	151	231	43	0	0	90	90	0	0	720
Costs	0	0	\$2415	\$3171	\$4851	\$2322	0	0	\$5760	\$5760	0	0	\$24,279
*Ninemile Acres	0	0	112	147	224	42	0	0	86	87	0	0	698
Costs	0	0	\$2352	\$3087	\$4704	\$2268	0	0	\$5504	\$5568	0	0	\$23,483
*Seeley Acres	0	0	13	18	27	5	0	0	21	0	0	0	84
Costs	0	0	\$273	\$378	\$567	\$1350	0	0	\$1344	0	0	0	\$3912
*Plains Acres	0	0	169	222	338	63	0	0	132	132	0	0	1056
Costs	0	0	\$3549	\$4662	\$7098	\$3402	0	0	\$8448	\$8448	0	0	\$35,607
*Superior Acres	0	0	97	127	194	36	0	0	76	75	0	0	605
Costs	0	0	\$2037	\$2667	\$4074	\$756	0	0	\$4864	\$4800	0	0	\$19,198
'96 Acres:	0	0	500	1000	1892	500	0	0	1520	0	0	0	6000
Total Costs													\$204,605
*Missoula Acres	0	0	135	243	472	121	0	0	100	200	0	0	1348
Costs	0	0	\$2970	\$5346	\$10384	\$6897	0	0	\$6700	\$13400	0	0	\$45,697
*Ninemile Acres	0	0	117	211	411	106	0	0	105	100	0	0	1173
Costs	0	0	\$2574	\$4642	\$9042	\$6042	0	0	\$7035	\$6700	0	0	\$36,035
*Seeley Acres	0	0	37	67	131	34	0	0	100	100	0	0	374
Costs	0	0	\$814	\$1474	\$2882	\$1938	0	0	\$6700	\$6700	0	0	\$20,508
*Plains Acres	0	0	144	260	505	130	0	0	110	300	0	0	1444
Costs	0	0	\$3168	\$5720	\$11110	\$7410	0	0	\$7370	\$20100	0	0	\$54,878
*Superior Acres	0	0	107	193	376	97	0	0	105	300	0	0	1073
Costs	0	0	\$2354	\$4246	\$8272	\$5529	0	0	\$7035	\$20100	0	0	\$47,536

Acreages & District Project Costs - Continued

for Proposed Ecosystem Fire Program

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
'97 Acres:													
Total Costs	0	0	520	1821	3000	1000	500	0	2000	1000	0	0	10,000 \$489,693
*Missoula Acres	0	0	352	403	713	238	100	0	118	118	0	0	2376
Costs	0	0	\$8096	\$9269	\$16399	\$14280	\$38200	0	\$8260	\$8260	0	0	\$102,764
*Ninemile Acres	0	0	577	376	633	211	100	0	106	106	0	0	2109
Costs	0	0	\$13271	\$8648	\$14559	\$12660	\$38200	0	\$7420	\$7420	0	0	\$102,178
*Seeley Acres	0	0	57	229	203	68	90	0	34	0	0	0	676
Costs	0	0	\$1196	\$5267	\$4669	\$4080	\$34380	0	\$2380	0	0	0	\$51,972
*Plains Acres	0	0	189	435	1433	270	100	0	135	135	0	0	2697
Costs	0	0	\$4374	\$10005	\$32,959	\$16200	\$38200	0	\$9450	\$9450	0	0	\$120,638
*Superior Acres	0	0	544	348	595	198	100	0	99	99	0	0	1983
Costs	0	0	\$12512	\$8004	\$13685	\$11880	\$38200	0	\$13930	\$13930	0	0	\$112,141
'98 Acres:													
Total Costs	0	0	1000	3000	3000	1000	500	0	2450	1000	0	0	12,000 \$815,570
*Missoula Acres	0	0	261	724	724	232	248	0	592	116	0	0	2897
Costs	0	0	\$6264	\$17376	\$17376	\$14616	\$99418	0	\$43808	\$8584	0	0	\$207,442
*Ninemile Acres	0	0	243	675	675	216	216	0	568	108	0	0	2701
Costs	0	0	\$5832	\$16200	\$16200	\$13608	\$86616	0	\$43032	\$7992	0	0	\$188,480
*Seeley Acres	0	0	64	179	179	57	57	0	122	29	0	0	716
Costs	0	0	\$1536	\$4296	\$4296	\$3591	\$22857	0	\$9028	\$2146	0	0	\$48,446
*Plains Acres	0	0	285	793	793	254	200	0	638	127	0	0	3171
Costs	0	0	\$6840	\$19032	\$19032	\$16002	\$80200	0	\$46842	\$9398	0	0	\$199,266
*Superior Acres	0	0	222	617	617	197	197	0	514	97	0	0	2466
Costs	0	0	\$5328	\$14808	\$14808	\$12411	\$78997	0	\$38406	\$7178	0	0	\$171,936

Key: Spring Burning Summer Burning Fall Burning

- ¹ Spring Burning Costs (March through June) represent specific FY costs (Appendix G)
Aerial Ignition.
Summer Burning Costs (July through August) represent specific FY costs (Appendix G)
Aerial Ignition.
Fall Burning Costs (September through October) represent specific FY costs (Appendix G)
Aerial Ignition.

* Ranger District acreages have been rounded off to the nearest whole number.

Funding Strategies and Partnerships

One of the critical items in the implementation of the Ecosystem Fire Program is funding. Just who should pay for the treatment of various areas of a national forest?

This is a big issue within the Forest Service, and the Lolo is no exception. In the past, prescribed fire was used primarily in relation to timber harvests. After a timber sale, there were designated monies (referred to as KV or BD monies) to reforest a site or reduce hazards and fire was part of that process. But as the five-year review of the Forest Plan revealed, the current amount of fire use is not enough to sustain some ecosystems. And as land managers are learning, ecosystem management projects may not always coincide with timber sales. So other benefiting functions must become involved.

Through the findings of this document, it has been determined that a number of departments (known as functions within the Forest Service) can benefit from restoring fire to ecosystems. The following criteria was used to determine what constitutes a benefiting function:

- Without scheduled treatment a negative effect would eventually occur to the function.
- Target accomplishments from a management area (MA) are not required for a function to be considered benefiting.
- With treatment a positive effect will occur to the function.

Using this criteria, some functions that have not historically been considered in relation to prescribed fire treatment have been identified. It is recommended that these identified functions should help pay for the costs of implementing a total ecosystem management program on the Lolo. The rationale for these allocations is provided below.

Fire Management - (70% of program costs in FY94 & 95. 65% in FY96 & 97. 50% in FY98.)

Historically this area has carried the major cost of natural fuels treatment. Our analysis supports this approach. This funding will be used in treating portions of all MAs to manage natural fuels buildup.

Range Management - (.5% of program costs in FY94 - 97. .3% in FY98.)

Limited use of financing from this function has occurred in the past. Since most of the range resource on the Forest is the result of transitory range, it was determined that burning would be beneficial to maintain or enhance the existing range resource. Only MAs used for grazing will be considered for funding. Sites with slopes greater than 40 percent will not be included. Additionally, MAs 10, 11 and 12 will not be included, since grazing use is limited in relation to other resource values.

Recreation - (1% of program costs in FY94 & 95. .5% in FY96 - 98.)

Burning for recreational values has been limited. In usage, however, a diverse open forest has more recreational value than one of heavy fuel accumulations and uniform

continued on next page

vegetation. Not only does it provide a more pleasing environment for recreational activity, but certain activities such as wildlife viewing, bird watching, wildflower variety and berry picking can be enhanced. Management areas primarily designed for recreational purposes or contribute to recreational enjoyment will be included.

Wildlife And Fish - (1% of program costs in FY94 & 95. 8% in FY96 & 97. 5% in FY98.)

Use of funds from this function have been common for forage production on winter ranges. Our analysis supports this use. All management areas designated to recognize wildlife values will be included, plus the MAs which contain significant areas of wildlife range.

INSECT & DISEASE - (2.5% of program costs in FY94 & 95. 1.5% in FY 96 & 97. 1.3% in FY98.)

Limited usage of this funding has been made in the past. A major contributor to some of our present pest problems has been the exclusion of fire and the resultant increase in more tolerant and also more pest susceptible species. Use of fire could decrease this risk significantly on a number of our plant communities. It was felt that usage of these funds would be appropriate on most of our MAs with a few exceptions. Management area 21 was not considered since our goal is to develop stands that may have a higher portion of tolerant tree species. Additionally MAs 10,11 and 12 were excluded since natural processes should guide structure in these areas.

Reforestation & Timber Stand Improvement- (2.5% in FY94 & 95. 2% in FY96-98.)

Use of these funds is common for site preparation. Limited attempts have been made to control stocking. The team felt that these uses were appropriate on regulated timber areas to prepare sites for regeneration or to reduce stocking levels of desirable species and eliminate or reduce stocking of undesirable species. Fire may also be used to retard regeneration in stands that are not ready for conversion to maximize growth on the crop trees and also provide a condition free of undesirable species when it is appropriate to regenerate the stand.

Soil And Water - (.5% of program costs in FY94 & 95. 3% in FY96 & 97. 2.3% in FY98.)

While this function has received limited use in the past, it seems reasonable to consider it under certain conditions. Examples can be listed where catastrophic fires have resulted in damage to the soil and water resource. This is of concern on areas that will have limited management of the vegetative resource, thereby allowing the accumulation of heavy fuel loadings. For this reason management areas that are not regulated will be considered candidates for funding with the exception of the wilderness areas. Wilderness areas will be treated to permit natural processes to occur and, as such, impacts are not necessarily good or bad.

Partnerships - (19% of program costs in FY94 & 95. 15% in FY96 & 97. 20% in FY98.)

Use of funds from this function have been common for forage production on winter ranges. Our analysis supports this use. All management areas designated to recognize wildlife values will be included plus management areas which contain significant areas of wildlife range.

Assignment of MAs to Functional Areas for Proposed Ecosystem Fire Program

MA	Functional Areas*								
	Fire	Range	Rec.	Wildlife/ Fish	Insect/ Disease	TSI	Soil/ Water	Reforest.	Partners.
I	X	X	X	X	X		X		X
9	X	X	X	X	X		X		X
10	X		X	X			X		X
11	X		X	X			X		X
12	X		X						X
16	X	X			X	X		X	X
17	X				X	X		X	X
18	X	X		X	X	X		X	X
19	X	X	X	X	X				X
20	X			X	X	X		X	X
20A	X		X	X	X				X
21	X		X	X		X		X	X
22	X	X		X	X	X		X	X
23	X	X		X	X	X		X	X
24	X	X			X	X		X	X
25	X	X			X	X		X	X
26	X				X	X		X	X
27	X				X		X		X
28	X		X	X			X		X

NOTE:

* Funding codes for functional areas.

115- Fire Management
050 - Range
070 - Recreation
080 - Wildlife and Fish

041 - Insect and Disease Control
034 - Timber Stand Improvement
090 - Soil and Water
033 - Reforestation

Functional Breakdown of Funding
for Proposed Ecosystem Fire Program

Program Area	FY94	FY 95	FY96	FY97	FY 98
Total Dollars	\$100,038	\$110,000	\$205,000	\$500,000	\$800,000
Total Acres	3,200	4,000	6,000	10,000	12,000
Fire Management	\$70,027/70%	\$74,535/70%	\$137,035/67%	\$328,094/67%	\$513,809/63%
Range	\$500/.5%	\$533/.5%	\$614/.3%	\$1,469/.3%	\$1,631/.2%
Recreation	\$1000/1%	\$1,065/1%	\$1,024/.5%	\$2,449/.5%	\$2,450/.3%
Fish & Wildlife	\$1,000/1%	\$10,000/8%	\$30,700/15%	\$73,454/15%	\$97,868/12%
Insects & Disease	\$2500/2.5%	\$2,662/2.5%	\$3,070/1.5%	\$7,345/1.5%	\$10,603/1.3%
Timber Stand Imp.	\$2500/2.5%	\$533/2.5%	\$4,092/2.0%	\$9,794/2.0%	\$16,311/2.0%
Soil & Water	\$500/.5%	\$3,195/.5%	\$614/.3%	\$1,469/.3%	\$1,631/.2%
Reforestation	\$3000/3%	\$3,195/3%	\$3,070/1.5%	\$7,345/1.5%	\$8,155/1%
Partnerships	\$19,000/19%	\$11,296 /12%	\$24,553/12%	\$58,764/12%	\$163,115/20%

Footnote: These figures only represent the actual burning dollars. Prep work funding needs will be established by each Ranger District.

PUBLIC INVOLVEMENT AND EDUCATION

For all the study of the ecology of a forest, it may be the study of *people* that will underwrite the success of ecosystem management. Since the Forest Service policy was announced in 1992, the need for more ground-level research has emerged as a priority. Few will argue with this. But when it comes to putting what has been learned about sustaining healthy ecosystems into practice on the land, there are many people with

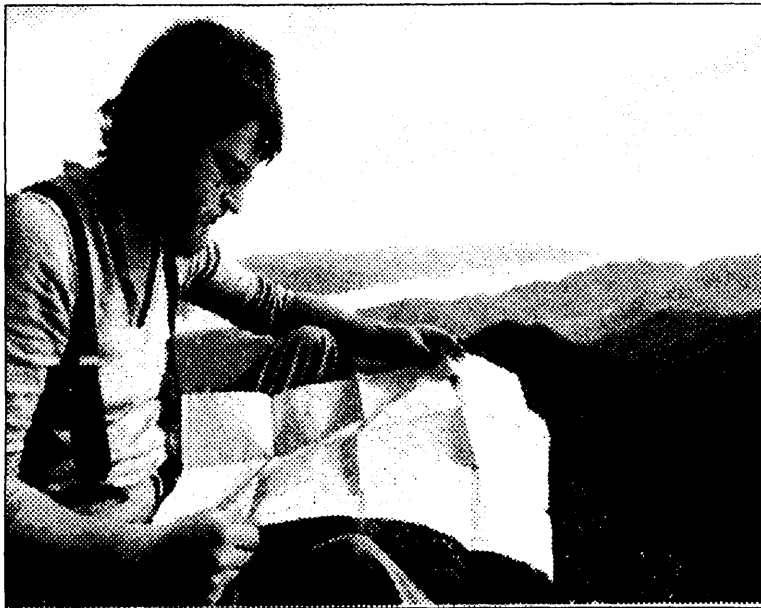


Photo: American Forests magazine

much to say, particularly in the west where there exists what historians and writers call a rugged individualism. In his book Community, Politics of Place, Daniel Kemmis suggests that most Americans never learn how to solve problems in a public arena. They can state their heartfelt opinions, but they have little practice in finding joint solutions. And finding solutions that work for people and the land is what must happen under ecosystem management, for without acceptance at the grassroots level, the philosophy will become only so much more data for Forest Service files.

So, what is the best approach when research into landscape ecology is continuing? Should ecosystems changed by human activities be left on their own to adapt to those activities? Should land managers try to minimize those effects and restore a natural force like fire, or its effects, where possible? If fire is prescribed for national forest lands, will private individuals support the policy when it means temporarily smoky skies and a season of blackened forest? Not unless they understand the program. Until the people who care about the land in and around the Lolo National Forest understand and trust the process, discussions about land management plans will remain adversarial.

Before his 1993 appointment as chief of the US Forest Service (USFS), research wildlife biologist Jack Ward Thomas spoke as an Albright Lecturer to the University of California and the subject of his talk was "Forest Management Approaches on the Public's Lands: Turmoil and Transition." He told his audience that the land should be considered "in a broader context than a series of single-use allocations to address specific problems or pacify the most vocal constituencies":

"We cannot continue along our present path of dealing with the assured welfare of individual species as constraints, and outputs of goods and services as objectives. The questions are bigger and

more complex.... [Meanwhile] the fighting goes on and accelerates in frequency and intensity. The people, our sense of community, and forests are bruised and battered in the process. The gladiators never tire of the fight --it is what they do. I detect, however, that many concerned about the forests we collectively own have long since approached exhaustion. This may be good news, for with exhaustion, there may come a willingness to seek an answer."

Part of finding that answer is being able to hear it. In Thomas's first written remarks to USFS staff, he emphasizes the importance of dialogue, from the bottom of the organization up, from the inside out:

"I want a Forest Service where everybody feels absolutely free to talk to the leadership, free to say what they want, free to speak their truth boldly.... I don't want you to tell me what I want to hear. I want you to tell me where we've got problems--if I were a boat captain I'd want to hear where the rocks and the shoals are...."

Also in this first address as USFS chief, Thomas acknowledges that presently ecosystem management is "more a concept" than a practiced policy. But at a time when resource agencies across the country are leaning toward larger landscape management approaches, Thomas predicts the Forest Service will become a leader in the field. And he calls for letting people see the change "on the ground." He says it's particularly needed in this time of much disagreement: "We no longer have the luxury of figuring out what is the best on our own and then just doing it," he says. "Now we have to involve the citizens of this country, everyone affected by or interested in what we'd like to do...."

Essentially, what he's speaking about is technology transfer: a massive, ongoing information exchange between staff of the Forest Service, between the USFS and its neighbors and landusers, and between the USFS and other land management agencies, be they state, federal local or private. Such an enterprise demands communications skills beyond most human beings.

In the case of fire management on public lands--and more specifically, in the case of prescribed fire being used to restore fire-adapted ecosystems and to minimize the human cost of wildfire--countless private and public agencies and individuals will be involved in the process and its outcome. How to address all those constituencies? Lolo Forest Supervisor Orville Daniels, in the proceedings from an April 1992 conference on the politics of wildfire, says his primary advice is "understand the why" when public or interagency discussion breaks down.

"Normally when we're trying to communicate with the public and something goes wrong --the public is behaving in a way we don't think is appropriate--we invariably as experts immediately go back to the facts and say, 'They don't understand the facts. If we just more clearly spell out the real facts to them, they'd understand.'

Take clearcutting for example. A person sees a clearcut and equates it somehow through his or her experience of destruction. It makes them upset and they begin to object to clearcutting. Using the classic model, we'd say, 'Let's just explain to them that it's good for the ecosystem. That you need to do it to grow trees.' It doesn't matter. They still see it as a hole in the forest. They still respond to it with the feeling of I-don't-like-it.

So instead of responding with more public information--more brochures--what we really need to do with the public is what a good psychologist or a person with good communication skills does, which is to tie into the feelings. Feelings are the doorway to understanding behavior. You've got to go inside and ask, What are the core values here? What experience made them interpret these facts in the way they did?

...The same analogy that I've used for clearcutting also applies to the use of fire in the ecosystem. Why do some people equate it to destruction when we know that, in the management of fire in the ecosystem, it may be very positive?

...Explore that "why." Why is the public behaving as they are? Or not behaving as we want them to? When we explore the why in some sort of systematic way, we make progress. It can be done in groups as well as in one-on-one situations, but only when I can figure out "why" did they feel the way they felt.

...My point is you've got to...train yourself so you can truly listen to people, understand what they're saying, and feed it back to them. It's the only way they'll know you heard them.

Don't be defensive or argumentative about it. The bottom line is the public needs to know that you listen to their concerns.... Once they know you have truly listened and taken into account their real basic problems, they are more apt to accept your decision. And it may not be your original message at all. Maybe you need to adapt your message. But rather than the old tried and true formula of public involvement that we've done, think about what public involvement really is and why it works."

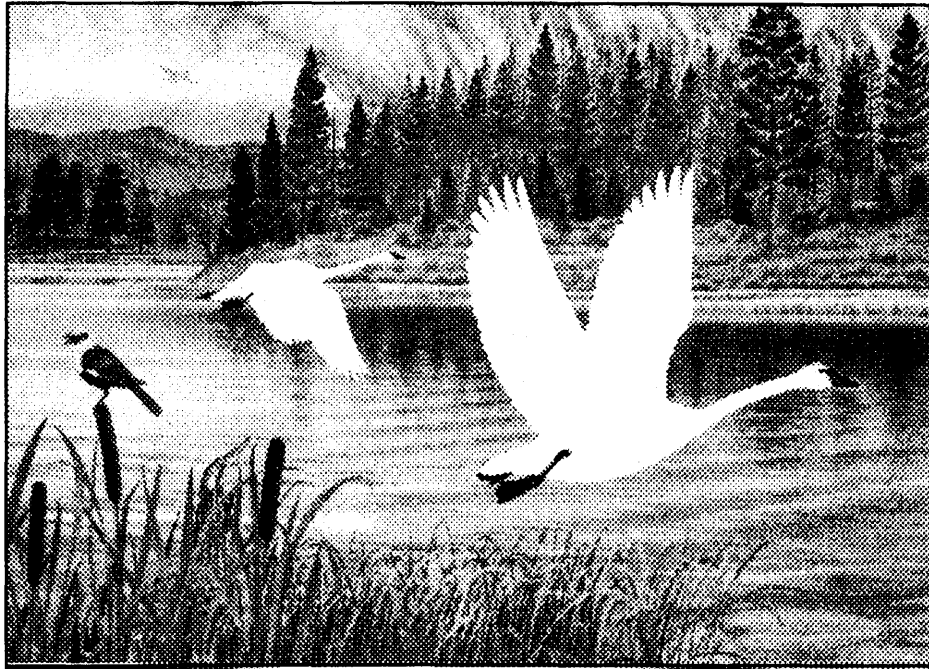
A scientist with the North Central Forest Experiment Station in Chicago, Illinois, Herb Schroeder suggests that managers go even further in understanding the why of people's emotions about the forest. In his paper *Ecology of the Heart: Restoring and Sustaining the Human Experience on Ecosystems*, presented in July of 1993 at a USFS seminar, Schroeder urges his fellow scientists to view the natural environment "not only in terms of scientific data, but also in terms of art and music...."

"...Our work requires us to have the best scientific information we can get about ecosystems. But we also need to consider the kinds of experiences that are expressed through art, music, and poetry. Otherwise we are leaving out a very important part of what makes us human. Part of restoring and sustaining experiences of ecosystems, then, is simply to recognize that these kinds of experiences are real and that they matter.

This has implications for the way we go about planning. By now I think most people in the Forest Service realize that we have to include people's values in the planning process. But what exactly do we mean by 'value'; how do we understand or conceptualize this term: Often, we think of value as a quantity--we try to understand it in terms of numbers and data. We look for ways to measure value, to analyze it, aggregate it, and maximize it. To the extent that we can do this, it becomes easier to deal with values in a scientific and objective manner. But if we look at value only in this way, something important may be missed.

To say that something has value is to say that it has the strength to move us, that is to arouse our emotions and motivate or push us into action.

--Herb Schroeder
USFS Scientist



Print: "Wildfire" by Monte Dolack

...Value and emotion are inseparable. Any time we are dealing with people's values, we are faced with emotion; and whenever we are confronted with strong emotions, we can be sure that something of value is at stake. There is simply no way to avoid emotions when making important resource management decisions."

The process of communicating, according to Schroeder, demands personal involvement and commitment to the process. Until a relationship has been developed that both sides think is worth saving, he says, conflicts won't be resolved.

Staff of the Lolo Forest's Missoula Ranger District had a chance to practice this emotion or value-based relationship building in 1993, and they met with some success. The District had targeted a watershed area near the city of Missoula as needing management to improve deer and elk forage, to encourage development of older ponderosa pine, and to reduce the risk of catastrophic fire on public lands. Missoula staff would say their plan--one of the first to take an ecosystem management approach--was designed to best benefit the land. The people who attended the initial public hearing on the project, however, saw the proposal for a limited timber harvest and prescribed burn as a way for the Forest Service to cut trees in a scenic or otherwise sensitive area. The community called for an environmental impact statement on the project.

Nine months later, after much one-on-one discussion, several tours and at least one letter to constituents acknowledging concerns, one of the most vocal opposition groups issued a five-page position paper endorsing work in the Northside area on a limited scale. The headline in the local paper on July 18th read "Grant Creek relents on logging: After crash course in ecology, homeowners agree to conservative cut."

What follows are some of the statements contained in the position paper from the Friends of Grant Creek (FOGC):

"FOGC is especially interested in the impacts, both positive and negative, of the Northside Analysis Area activities. FOGC acknowledges that this forested area has been artificially managed for many years, largely by fire suppression, in a way that has created an abnormally high fire fuel load, an abnormally low amount of wildlife forage, and unnatural stands and mixtures of timber. We also understand that there may be some economic connection between Forest Service income from timber harvest in the Northside Analysis Area and the Forest Service's ability to accomplish the maximum amount of fire hazard reduction and wildlife forage enhancement.

FOGC encourages the minimum amount of timber harvest compatible with the economic viability of the project and with the goals of fire hazard reduction, wildlife forage enhancement, insect infestation prevention, desirable tree species encouragement and retention and maintenance of existing old growth stands....

To those expressing concern about the various impacts of the Northside Analysis Area proposal, the Forest Service has repeatedly answered that forest management practices have evolved considerably over the last few years. They also point out the dramatic difference between the forest management practices that are often viewed on the properties of large, private landholders, and the current best practices applied by the Forest Service."

The position paper (Appendix H), which lists the group's amendments to the original plan, concludes as it begins, with a challenge for the Forest Service to make the Northside Analysis Area project a "showcase."

"...Demonstrate to the citizens of Grant Creek and Western Montana that [the USFS] can implement forest management practices that are wholesome for the forest, and are environmentally, aesthetically and economically acceptable to the citizens who use, appreciate and own the forests...."

Though there are other groups who continue to oppose the project, Missoula District staff say their success with FOGC can be attributed to their efforts to build a one-on-one relationship with constituents.

Ecosystem management, if fully implemented, will involve the agencies and people who have a vested interest in the land. But the philosophy, particularly in regards to ecosystem fire, needs to reach a larger public still with the message that fire is natural, that forest sustainability depends on a cycle of fire, and that fire's exclusion, through suppression, for more than 80 years has created a set of complex problems that can't be solved painlessly (see inset on next page).

Thanks to some media followup to the 1988 fires in Yellowstone National Park, people are beginning to understand that fire is not the great evil that caretakers of the forest once warned that it was. And yet as a staff briefing paper developed for fire management officers in the Northern Region of the USFS points out, the general public has been "predisposed to think of wildland fire as an enemy through prevention vehicles

Forest Service Facts About Fire

Through a committee process, Northern Region USFS staff have identified four messages that fire management needs to convey to the public and all those involved in wildland management:

WILDLAND ECOSYSTEMS ARE ALWAYS CHANGING AND FIRE IS ONE OF THE MAJOR AGENTS OF CHANGE IN THE RENEWAL OF ECOSYSTEMS.

Researchers say that fire always has been and always will be a part of the Northern Rocky Mountain ecosystems. Removing it from the equation, they say, is humanly impossible: There are approximately 1,000 to 1,200 lightning-caused ignitions every year on Northern Region lands alone. Suppressing these fires is possible for a time, but in ecosystems historically adapted to fire, the exclusion of this force has caused changes that will and have led to changes in the ecosystem itself. The message that fire is natural and often beneficial is one that people in and out of the Forest Service need to embrace. Internally, staff must take fire into consideration on any land management decision, particularly in the early stages of the planning process.

FIRE SUPPRESSION HAS A PLACE IN WILDLAND MANAGEMENT.

This message was included to reassure those who fear the USFS will be compromising its fire suppression capabilities because of the Ecosystem Management policy and its renewed attention to prescribed fire. The USFS plans to continue its job of protecting resources, property and lives in the most cost-effective manner.

FIRE EXCLUSION HAS AN ENVIRONMENTAL COST.

Summarized more fully on page 20 of this document, these environmental costs are increased forest stagnation and mortality from insect and disease epidemics, loss of natural diversity and wildlife habitat, and heavy buildup in the forest understory, which means heavier fuel for a larger, more severe wildfire. Larger, more intense wildfires often result in more significant impacts to water, soil and air resources.

ACHIEVING ECOSYSTEM MANAGEMENT OBJECTIVES THROUGH THE USE OF FIRE GENERATES SOCIAL TRADEOFFS.

This message is key. If society accepts that fire in some ecosystems is natural and revitalizing, then it must understand that allowing fire to play whatever role it can on the landscape in these contemporary times is not without consequences. The risk of a prescribed fire's escape is always a top concern for USFS fire managers, but they want the American public to understand that if it comes down to the risks of prescribed fire versus wildfire, the risks of wildfire are of more concern. Wildfires start where they want, are bigger in size, and are more severe in areas where fire has been suppressed.

**The earth, born in fire,
baptized by lightning,
since before life's
beginning has been
and is, a fire planet.**

--E.V. Komarek

like Smokey Bear." If ecosystem fire is to ever find acceptance, there must be a new message: Only You Can Promote Forest Health by using a land management tool that, like anything else in life, has costs.

The most prominent concerns about ecosystem fire identified by the Northern Region fire staff are smoke, aesthetics and personal risk. In Montana, according to US Forest Service (USFS) statistics, the annual amount of smoke generated from forest and range fires has generally decreased since the early 1900's, even with today's use of prescribed fire (see Appendix I). However, air quality standards are being tightened across the country. It was, in fact, air quality concerns among others that prevented fire managers in Southern California from using prescribed fire to reduce vegetation buildup in the residential canyon areas that burned in October of 1993. Now thousands of residents know first hand the devastating sociological effects of wildfire. Only time will tell, however, if this experience will create new public acceptance for prescribed fire and its effects.

A quantity of smoke is
an unsettling commodity.
The human being does
not like to think its
environs are flammable.

--Ivan Doig
English Creek

But even as the USFS reaches out to the public, the truth is acceptance of fire in the ecosystem must begin within the Forest Service. After all, according to historian Stephen Pyne's 1982 book Fire in America, the USFS was reborn in 1910 to the cause of stopping wildfire in its tracks, after the ecologically, sociologically and economically devastating fires of that year which burned thousands of acres of timber and town throughout the west and claimed 87 lives. The Big Blow-Up of 1910, according to Pyne,

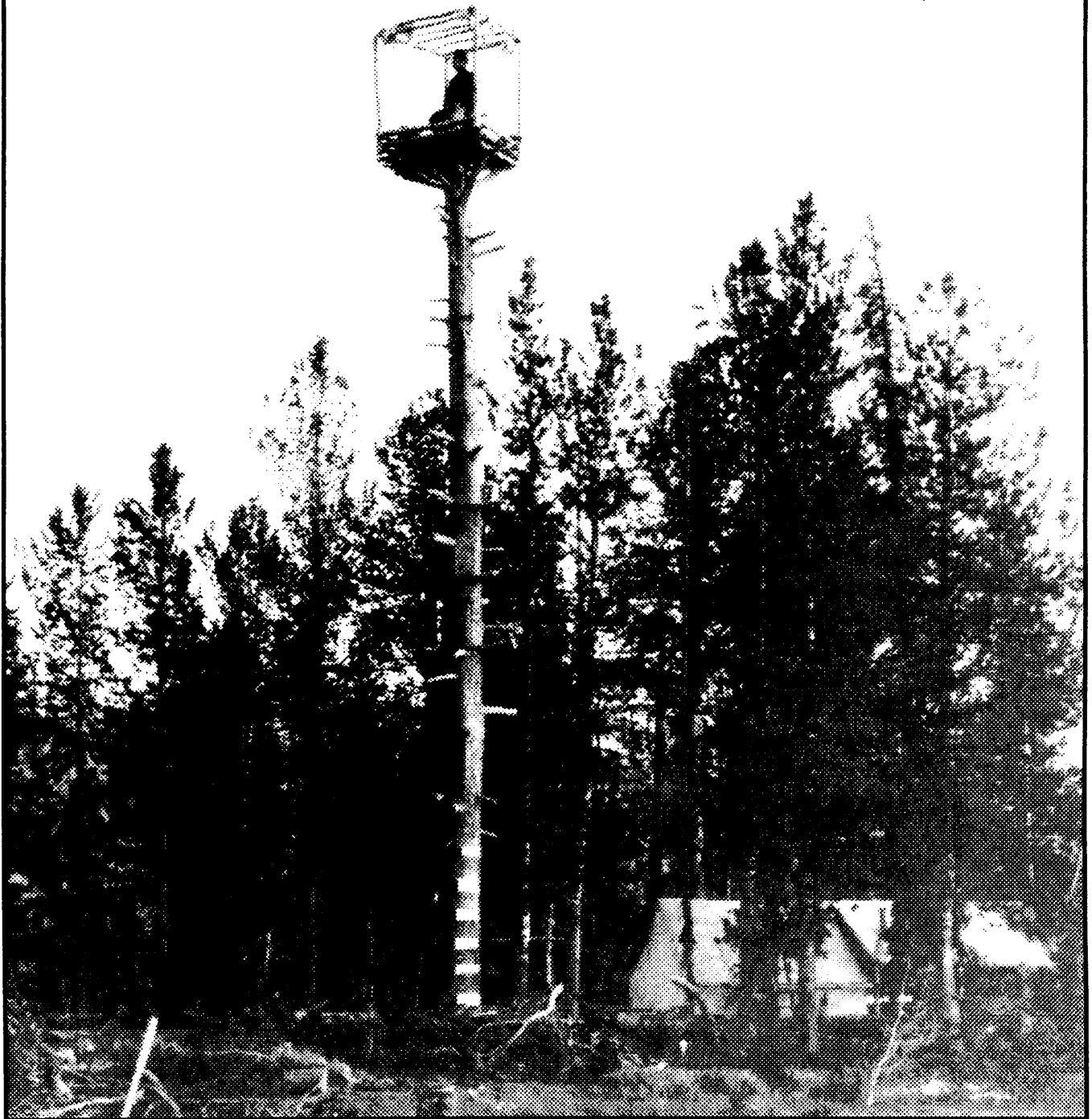
was the Forest Service's "Valley Forge, its Long March." It created the USFS maxim that all wildfires were to be controlled by 10 am the next day.

Given this long-held prejudice against wildfire's burning of resources, there are, of course, other sensitivities. A watershed specialist, for example, may understand the potential benefits of fire in the ecosystem and yet resist the increased sediment in rivers and streams. However, researchers studying the effects of fire on the landscape point out that the effects of prescribed fire are generally less damaging than those of wildfire. More importantly, they say, there are long-term benefits worth the short-term effects.

This internal USFS change toward acceptance of fire in the ecosystem will take time, but as the policy of ecosystem management develops within the USFS, it must be seen and felt by the general public. In other words, if the Forest Service is still considered by the public to be a congressionally-mandated tree farmer, then its actions must demonstrate otherwise. If the Forest Service is truly to bring people into the equation of land management decisions, then it must understand "the why" of their opposition. Once the message is understood and supported by the public, part of the job of sustaining healthy ecosystems will already be accomplished. The USFS will have partners in their quest to solve forest health problems in fire-dependent ecosystems, partners who not only know what they want from the forest, but what the forest needs from them. ■

"These are....interesting times, exciting times, critical times. When the history of conservation in the United States in the 20th century is written, I believe this period will loom as large, for good or ill, as the times of Pinchot and Roosevelt. We...are privileged indeed to stand this watch."

- Jack Ward Thomas, 1985



MONITORING

The Ecosystem Fire Program outlined in this document will be managed at the forest-level through a four-person team consisting of the Lolo's fire management officer as the team leader, the forest's silviculturist, budget and finance officer, and wildlife biologist. This team will annually review the program and set forest program levels for the outyears. District rangers will determine program management responsibilities at the Ranger District level. Partnership funding will be the responsibility of the forest level team.

Project level monitoring will be accomplished through existing Forest Plan monitoring procedures. Districts will continue to evaluate all projects through the existing post-burn analysis process.



Photo: US Forest Service

APPENDICES

APPENDIX A

Lolo Forest Management Areas

Though Lolo Forest managers have identified Ecosystem Management Areas upon which to base their landscape planning, they will still rely on the goals of the 29 Management Areas (MA) outlined in the Forest Plan. Each is described below as it appears in this plan, but also included is an overlay of fire management strategies aimed at reproducing fire in the ecosystem in as near-natural conditions as possible.

Management Area 1

35,686 Acres

- Consists of nonforest and noncommercial forest land scattered over the forest at all elevations. The area is not considered suitable for timber management; however timber salvage and firewood removal may occur where access exists.

Habitat & Fire

The major habitat groups are O and 6 and are characterized by high variability in species composition and density.

Vegetatively the area is composed of a variety of plant communities ranging from meadows, mountain grasslands or balds, snow chutes, talus slides or rock outcrops, to tree communities on scree types, forested rock and high elevation sites.

Habitat Group O -

Represents the major portion of the MA. All group habitat types are found.

Because of the wide diversity of this habitat group, the vegetative community must first be defined for each area. Definition of the community structure is the responsibility of the Ranger District with the assistance of the zone ecologist and wildlife biologist. Ecosystem Maintenance Burning objectives may then be developed. Burning may be undertaken in conjunction with adjacent management areas when it will facilitate the burn layout.

Habitat Group 6 -

The high elevation portion of the Lolo Forest outside of wilderness and roadless areas is found in this MA. No Ecosystem Maintenance Burning will be conducted unless in conjunction with adjacent units.

Minor inclusions of Habitat Groups 2,3,4 and 5 are also found in this management area and may be treated with adjacent MAs if practical.

- The goal for the area is to maintain near-natural conditions. Management practices intended to maintain wildlife habitat are permitted.
- Prescribed burning may be conducted to maintain or restore the composition and structure of plant communities, or for hazard reduction. Wildfires will be confined, contained or controlled.

Management Area 2:

3,374 Acres

- Includes the administrative sites on the forest.
- Ecosystem Burning will not apply. As a result of site planning, it may be determined that prescribed fire is appropriate to meet MA objectives.

Management Area 3:

60 Acres

- Includes cultural and/or historical sites of significance on the Lolo Forest.
- Because of the threat to values, fire will not be used, except as needed to meet MA objectives.

Management Area 4:

265 Acres

- Represents active or recently active mining sites on the Lolo Forest.
- Because of the interests of private individuals, fire will not normally be a tool used for management of these sites.

Management Area 5:

1,581 Acres

- Consists of transportation and utility corridors found on the forest.
- Problems with smoke columns and electrical conductance preclude the use of fire at this time.

Management Area 6:

3,307 Acres

- Represents research natural areas and botanical areas.
- Each of these areas will have a management plan and the use of fire will be addressed there.

Management Area 7:

343 Acres

- Includes the campgrounds and picnic areas on the forest.
- Fire use in these areas will be addressed in the Vegetative Management Plan for each facility.

Management Area 8:

664 Acres

- Ski areas found on the Lolo Forest.
- Fire use may be necessary to meet MA objectives and will be addressed in the special use permit for each area.

Management Area 9:

17,226 Acres

-- Consists of parts of the forest that receive concentrated public use for dispersed recreational purposes.

Habitat & Fire

Habitat Group O -

This area is generally represented by mountain grasslands. Past grazing and disturbance has resulted in many of these acres being invaded by noxious weeds such as knapweed and leafy spurge. Tree encroachment is occurring on some areas, reducing their recreational and grazing values.

Objectives for specific species composition must be determined on each site to help determine necessary fire treatment. Generally, employ a fire return interval that maintains the natural openings. Light spring burns,

- Management goals for the area include providing for a wide variety of dispersed recreation opportunities in a forest setting, management of other resources consistent with recreation objectives, and maintaining acceptable levels of water quality and fisheries habitat.
- Prescribed burning may be conducted to maintain or restore the composition and structure of plant communities or for hazard reduction.
- The Ecosystem Fire Program strategy will be to encourage a fire frequency that emulates the natural role of fire while recognizing other resource needs.

continued

Management Area 9: (Continued)

17,226 Acres

-- Consists of parts of the forest that receive concentrated public use for dispersed recreation.

Habitat & Fire

ranging from 10 to 40 years intervals, are tested.

Habitat Group 1-

The strategy will be to maintain open grown communities of old growth ponderosa pine with limited understory. Sites with heavy rough buildup and/or numerous seedlings should be priority stands for treatment. Prescribed fire intervals of 10 to 40 are tested and modeled as a light spring underburn.

Habitat Group 2 - These sites will be managed to maintain somewhat open, grown communities dominated by ponderosa pine with a shrub layer containing a high percentage of seral shrubs. Ponderosa pine will generally represent about 75% of the stand.

Reproduction may occur as individual trees or small groups, but should not dominate the understory. The shrub layer will generally contain ninebark, but chokecherry, ceanothus, and serviceberry should be significant members of the community.

Prescribed fire will typically occur on a 30 to 45 year cycle. However, because of past fire exclusion, more frequent, less severe treatments may be necessary until stand conditions are modified to reduce the risk of a replacement type burn. Communities with a significant understory of Douglas-fir with a high incident of spruce budworm, root rot or mistletoe, or those with decadent shrubs or heavy accumulations of down material should have a high priority for treatment.

Habitat Types

- Group 0 - Alpine and barren, scree, rockland mountain grassland, meadows, mountain brush, snow chutes and alder glades.
- Group 1 - Warm, droughty tree communities (Ponderosa Pine and Douglas fir dominant), wheatgrass, snowberry, fescue and pinegrass.
- Group 2 - Warm dry to moist of Douglas fir series, dwarf huckleberry, ninebark, snowberry, pinegrass, arnic, spirweo, kinickinnick
- Group 3 - Cool dry types of Douglas fir series, huckleberry, twinflower, pinegrass, elk sedge, juniper
- Group 4 - Characterized by above-average moisture, favorable to tree growth, bedstraw, twinflower, beargrass, beadlily, devil's club, bluejoint
- Group 5 - Alpine fir, dwarf huckleberry, beargrass, pinegrass
- Group 6 - Transition between forest and alpine communities, whortleberry, woodrush

continued

Management Area 9: (Continued)

17,226 Acres

-- Consists of parts of the forest that receive concentrated public use for dispersed recreation.

Habitat & Fire

Habitat Group 2 - (continued)

Fire will generally be applied as an underburn. If the shrub component has a good representation of seral shrubs, spring burning should be employed. However, if the seral shrub component is to be increased, fall burning may be required. When stand replacement is required, timber harvest and/or a hot fire may be used.

Habitat Group 3 -

These communities are characterized by mixtures of Douglas-fir and western larch with various amounts of ponderosa and lodgepole pine. Understories vary, but frequently should have minor to moderate amounts of seral shrubs.

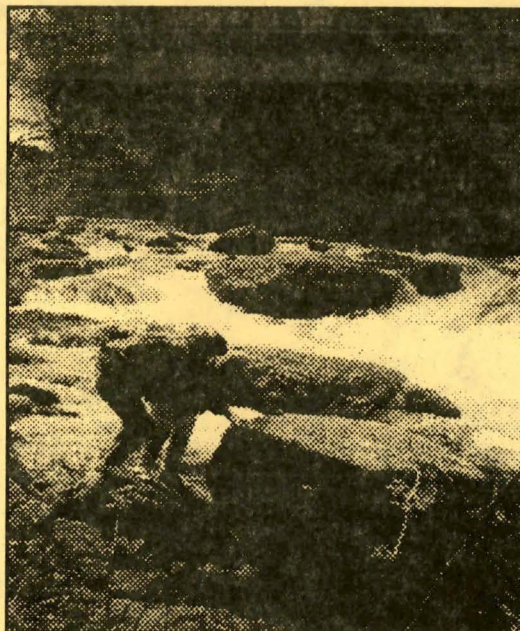


Photo: USFS

Management objectives are to maintain a relatively open, grown overstory with limited reproduction in the understory. In treating these sites, losses of small areas to high intensity fire must be recognized and considered a normal effect of fire treatment. Priority should be given to stands with heavy fuel loadings, overmature lodgepole pine, or heavy stands of reproduction. Fire will normally be applied as an underburn, but in some cases where lodgepole is a major species, a replacement type fire may be applied. Timber harvest may be considered as an option in treating these conditions. Fire treatment should occur every 40 to 60 years, generally in the fall.

Habitat Group 4 -

With the exception of the GF/Xete habitat type, fire occurred naturally on a 150 year frequency varying from 30 to 500 years. The shorter frequencies are normally light underburns, while the longer frequencies represent stand replacement events.

This group will be managed in a manner which permits relatively dense understory coverage. It does not appear that the community is as dependent on fire for maintenance of ecosystem health as those discussed above. Climax tree species on these sites generally grow well in contrast to the groups described previously.

continued

Management Area 9: (Continued)

17,226 Acres

-- Consists of parts of the forest that receive concentrated public use for dispersed recreation.

Habitat & Fire

Habitat Group 4 - (continued)

Moisture levels and temperatures in the soil are such that decomposition of dead plant material is optimized, thereby maintaining the flow of nutrients back into the soil. For this reason fire will not be scheduled on these sites, but rather it may be desirable to use timber harvest to recycle these sites with fire a part of the slash abatement plan.

Habitat Group 5 -

These communities are dominated by lodgepole pine with various amounts of subalpine fir and Douglas-fir. Understories are composed of mixtures of huckleberry and beargrass with minor amounts of other shrubs. Frequent light ground fires appeared to have been common with stand replacement fires occurring about every 100 to 200 years.

Management objectives will be to maintain relatively open stands of lodgepole pine and promote mixed species tree communities where possible. Lodgepole pine stands should be scheduled for replacement at about 100 years either with fire or timber harvest and burning. Future studies may show it to be advantageous to use a fall burn on young stands at age 30 to reduce stocking and stand stress.

Habitat Group 6 -

No treatment will be planned. During project analysis, they may be evaluated for burning in conjunction with treatment of adjacent sites.

Prescribed fire will not normally be considered for this type except if it is a logical inclusion for ease of burning adjacent areas. Where this type is found in essential grizzly bear habitat, burning may be used to provide bear foods. This activity will normally be associated with snow slides or meadows.

Management Area 10

7,913 acres

-- Consists of small, unroaded parcels of land scattered throughout the forest.

- The management direction is similar to MA 11. However, because of the small unit size, the priority for treatment is lower. This management area has a Visual Quality Objective (VQO) of Retention and the landscape architect should be consulted in the development of burning plans.

Management Area 11:

160,982 Acres

-- Represents the major portion of the forest outside of wilderness that is unroaded and will be maintained in this condition over the planning horizon. Generally, MA 11 is found at mid to upper slopes along the major divides on the forest.

Habitat & Fire

Habitat Group 1 -

Use of fire will be directed toward maintaining open, park-like conditions and toward maintaining forage palatability.

Generally these communities will be burned every 20 to 40 years with a light spring underburn. Key factors in selecting areas will be loss of grass under ponderosa pine because of needle accumulation, "rough buildup," or a significant amount of reproduction.

Habitat Group 2 -

Fire treatment of these sites will be similar to MA 9 with emphasis on maintenance of ponderosa pine and western larch in the stand, stimulation of browse species, and reduction of fuel buildups.

Burning will occur on a 30 to 45 year cycle. Burns will normally be light spring underburns, unless seral shrubs need stimulation. The application of fire may be controlled by past fire exclusion; and frequencies or intensities may be modified to meet site conditions. Key factors for select-

continued

- Management goals for the area are to provide dispersed recreation activities in a near-natural setting.
- Prescribed burning may be conducted to maintain or restore the composition and structure of plant communities or for hazard reduction.

Unplanned ignitions will be managed under direction for Fire Management Unit (FMU) 4. A fire management plan will be developed for each area to determine the feasibility to let natural ignitions burn. For those areas that meet this requirement, no scheduled burning will be planned.

At the end of the planning period these areas will be assessed to determine if significant fuel problems are developing because of the lack of natural ignitions. If it is judged that a problem exists, the direction developed for the remaining areas without a fire management plan will be used for implementing a program on these problem areas.

For this analysis it is assumed that 50 percent of the MA will be addressed under a fire management plan. The management area has a Visual Quality Objective of Retention (VQO) and the landscape architect should be consulted in the development of burning plans.

Management Area 11: (Continued)

160,982 Acres

-- Represents the major portion of the forest outside of wilderness that is unroaded and will be maintained in this condition over the planning horizon. Generally, MA 11 is found at mid to upper slopes along the major divides on the forest.

Habitat & Fire

ing stands to be treated are ladder fuel buildup, significant increase in tolerant tree species, and decadence or loss of shrub species.

Habitat Group 3 -

Emphasis will be to maintain relatively open stands of Douglas-fir or western larch and will be treated similar to MA 9.

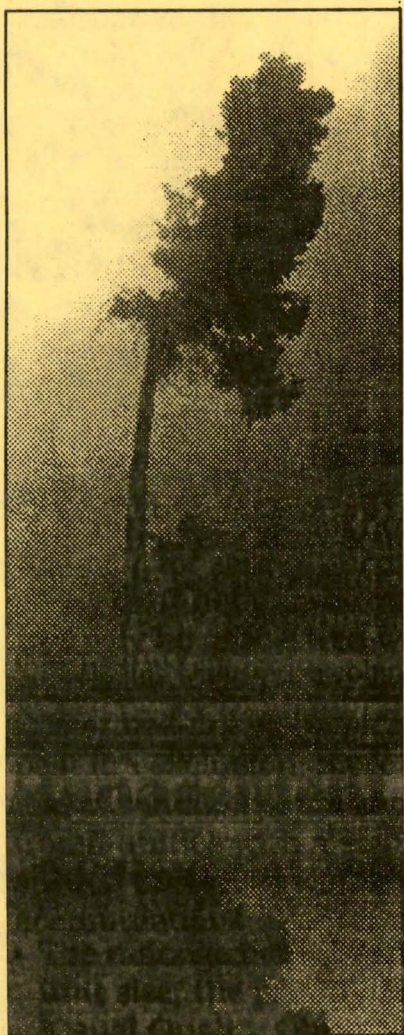


Photo: USFS

Fire frequency will average 50 to 60 years with emphasis given to treating stands with root rots, mistletoe or budworm damage. Because of the amounts of lodgepole pine found on these sites, a higher proportion of the burns may result in replacement type events and will normally occur in the fall.

Habitat Group 4 -

These sites with the exception of the GF/Xete portion will generally not be scheduled for treatment for the same reasons as mentioned in MA 9. It may be appropriate, however, to treat them in conjunction with adjacent sites. Grand fir/beargrass sites will be treated the same as Habitat Group 3.

Habitat Group 5 -

Generally these communities are dominated by lodgepole pine. Stand replacement fires play a role in maintaining this species.

The strategy will be to maintain lodgepole pine at the expense of subalpine fir. The fire return interval will average 100 to 150 years and will be applied as stand replacement fires. While light underburns were common in this type, they will not be scheduled.

Management Area 12:

363,308 Acres

- Contains the existing and proposed wilderness areas on the forest.
- The role of fire will be addressed in fire management plans developed for each area.

Management Areas 13 & 14:

55,955 Acres

- Consists of riparian areas which are relatively narrow units along streams or around lakes.
- The configurations of these MAs does not lend themselves to individual treatment; therefore, ecosystem burning direction will not be developed specifically for these MAs. The areas may be treated in conjunction with surrounding MAs.

Management Area 15:

282 Acres

- Contains grasslands that will be managed intensely for grazing.
- Fire will not be scheduled on these sites. However, fire may be used in the management of specific areas as determined by the grazing plan.

Management Areas 16 & 17:

728,649 Acres

- Represents the bulk of the forest allocated to production of forest products.

Habitat & Fire

Habitat Group 1 -

This group represents a small portion of the MA. Periodic burning to help nutrient cycling and reduce regeneration under immature stands will help to optimize production on the site. A

- The general management direction is to maintain healthy stands and optimize timber growing potential as well as provide for dispersed recreation, wildlife habitat and livestock use.

continued

continued

Management Areas 16 & 17: (Continued)

-- Represents the bulk of the forest allocated to production of forest products.

Habitat & Fire

frequency of 10 to 30 years is projected for the site. The majority of the area will be treated by selection or group selection harvest with an anticipated fire entry frequency of 30 years. Since burning can be done in conjunction with these entries, no additional burns may be needed.

Habitat Group 2 & 3 -

A timber rotation on these sites will generally be about 100 years, at which time fire may be used for slash abatement and/or site preparation.

A normal fire frequency on these sites ranges from 20 to 60 years which suggests that limiting the use of fire in conjunction with timber harvest is less than optimum for ecosystem health. The problem can be addressed with a burning entry at mid-rotation or when the stand is about 50 years old. The treatment is particularly valuable on sites that will be regenerated using a shelterwood system. This treatment will help maintain a better shrub viability for wildlife and livestock; retard the development of an understory of tolerant species thereby providing better crop tree growth; reduce the fire risk; and limit the build-up of pest populations such as spruce budworm by limiting their food supply.

Because of past fire exclusion it may be desirable to burn these sites prior to timber harvest to provide a wider range of treatment options. These burns will be conducted in the spring and will be geared primarily to reduction of understory Douglas-fir, slash abatement and site preparation.

Habitat Group 4 & 5 -

Since the normal fire return period is similar to the rotation age used on these sites no burning with the exception of the GF/Xete type will be scheduled beyond that which is programmed at the time of stand regeneration. The GF/Xete type will be treated the same as Habitat Group 3.

Small inclusions of Habitat Group 0 & 6 may be found in this MA, but are not scheduled for management. The fire strategy will be the same as for MA 1.

- Prescribed burning may be used to maintain or restore the composition and structure of plant communities or for fire hazard reduction. Wildfires will be confined, contained or controlled.
- To optimize the timber growing potential of these sites, seral species are often featured because of their growth characteristics. Ecosystem Maintenance Burning can be used to help maintain seral species, recognizing the need to protect economic values.

Management Area 18:

106,271 Acres

-- Includes forested land that provides winter range for big game species and is suitable for timber management.

Habitat & Fire

There are three components to winter range: forage areas, hiding cover, and thermal cover. A community may fill all three components during certain portions of its life and this concept is used in developing the fire strategy for the Habitat Groups.

Habitat Group 1 -

On areas that will not sustain a shrub component, light spring underburning will be conducted on a 10 to 40 year frequency. The objective will be to remove needle litter and rough and stimulate the grasses.

On shrub ranges, burning will be less frequent and geared to rejuvenating decadent shrubs. Fire will normally be applied to stimulate existing shrubs rather than establishment of new shrubs. For this reason spring burning will be applied. Cutting will normally be done by a selection system and stand structure will be all aged. Burning frequency will average between 25 and 40 years and be accomplished in conjunction with timber harvest activities. This group generally provides foraging areas for big game.

Habitat Group 2 -

While providing some forage throughout the stand life, these sites will be featured for forage during the first 60 years. At stand age 20 to 40 years a light underburn will be used to rejuvenate existing shrubs. Normally this will be a spring burn and can be applied as part of a project to achieve tree thinning and/or reduce thinning slash. Treatments must recognize the need to maintain normal tree stocking. Generally they will be burned with a moderate to hot fire at the time of regeneration for site preparation needs. This type of burn will be effective in establishing new seral shrub species.

Because of past fire exclusion, it may be desirable to burn these sites prior to timber harvest to provide a wider range of treatment options. These burns will be conducted in the spring and geared primarily to reduction of understory Douglas-fir, slash reduction and site preparation.

- Management goals are to optimize forage production and cover for deer, elk, and bighorn sheep and maintain healthy stands of timber for optimum growth potential.
- Prescribed burning may be used to maintain or restore the composition and structure of plant communities or for hazard reduction. Wildfires will be confined, contained or controlled.

continued

Management Area 18: (Continued) 106,271 Acres

-- Includes forested land that provides winter range for big game species and is suitable for timber management.

Habitat & Fire

Habitat Group 3-

These sites do not normally provide the forage opportunities as compared to Habitat Group 2 communities. Tall seral shrubs may become established on portions of this group when burned in conjunction with site preparation. These sites may be treated similarly to Group 2 with a light underburn at stand age 40 to 60 years. Burns may have to be conducted in the fall since these sites are commonly too moist for spring burning.

Habitat Group 4 -

While the site is a good shrub producer, tree growth soon shades out many of the preferred species. Use of fire as described above may not be effective on the site because of the crown cover of the trees which will retard the growth response of the shrubs. These sites do provide good thermal and hiding cover and, therefore, fire will be used only at the time of regeneration (with the exception of the GF/Xete habitat type which may be treated the same as Habitat Group 3.)

Habitat Group 5 -

This combination is found only on bighorn sheep range and is principally important for cover. Application of fire will be limited to treatment at the time of stand replacement.

Habitat Group O -

Small areas of this habitat group may occur as inclusions and will be managed as MA 19.

Habitat Types

- Group 0 - Alpine and barren, scree, rockland mountain grassland, meadows, mountain brush, snow chutes and alder glades.
- Group 1 - Warm, droughty tree communities (Ponderosa Pine and Douglas fir dominant), wheatgrass, snowberry, fescue and pinegrass.
- Group 2 - Warm dry to moist of Douglas fir series, dwarf huckleberry, ninebark, snowberry, pinegrass, arnic, spirweo, kinickinnick
- Group 3 - Cool dry types of Douglas fir series, huckleberry, twinflower, pinegrass, elk sedge, juniper
- Group 4 - Characterized by above-average moisture, favorable to tree growth, bedstraw, twinflower, beargrass, beadlily, devil's club, bluejoint
- Group 5 - Alpine fir, dwarf huckleberry, beargrass, pinegrass
- Group 6 - Transition between forest and alpine communities, whortleberry, woodrush

Management Area 19:

82,170 Acres

-- Provides winter range for big game animals. Found on sites which are unsuitable for timber production.

Habitat & Fire

Fire use strategy will be similar to Management Area 18, except most of the area will be maintained in foraging conditions; frequencies will be such that they not only assure ecosystem health but also optimize forage production for big game.

Habitat Group 0 -

The portion of the habitat group normally associated with winter range is shrubfield or scree types with a significant shrub community. Burns will normally be applied in the spring to rejuvenate seral shrubs. Occasionally fall burns may be required to initiate new seral shrubs lost through succession. Fire return frequency will average 30 to 40 years.

Habitat Group 1 -

Fire will be applied the same as in MA 18. However, logging will generally not occur. Major portions of the area may have only scattered mature ponderosa pine and appear as a savanna.

Habitat Group 2 - [THIS AREA IS THE HIGHEST PRIORITY FOR TREATMENT ON THE LOLO FOREST.] Treatment will be geared to maintain open or scattered stands of ponderosa pine and Douglas-fir. Shrub fields may occupy portions of the area.

Timing and fire intensity will vary, dependent on the condition of the shrub layer, but normally will range between 20 and 40 years. Burns may be applied to kill patches of trees when the overstory becomes too dense for optimum shrub development. When the overstory becomes decadent (about 200 years) timber harvest or a stand replacement burn will be initiated.

Habitat Group 3 -

A strategy similar to Habitat Group 2 will be used except the burning frequency will be 40 to 60 years.

- Management goals are to optimize deer, elk, and big horn sheep winter range and provide dispersed recreation opportunities.
- Prescribed burning may be used to maintain or restore the composition and structure of plant communities or for hazard reduction. Wildfires will be confined, contained or controlled.

continued

Management Area 19: (Continued)

82,170 Acres

-- Big game animal winter range. Generally unsuitable for timber production.

Habitat & Fire

Habitat Group 4 -

These communities will normally provide cover and are generally associated with stream riparian zones that bisect the other habitat groups.

Fire may occur through natural ignitions, at which time a contain, confine strategy may be used. Stand replacement should occur at about stand age 150, either through a planned or natural ignition or timber harvest.

The GF/Xete type will be treated in the same manner as Habitat Group 3. For planning purposes 50% of the area will be scheduled for planned ignition.

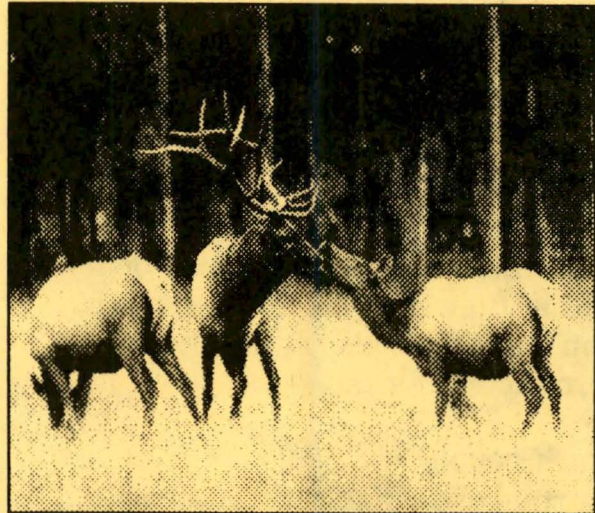


Photo: Rocky Mountain Elk Foundation

Management Area 20:

71,716 Acres

-- Found at mid to upper slopes on areas designated as essential grizzly bear habitat.

Habitat & Fire

Slash treatment and site scarification will be done in such a way as to optimize huckleberry production or wet-site forbs for grizzly bear foods.

Minor inclusions of Habitat Group O will be treated as MA 20A. Timing of ecosystem burning will be the same as MA 16 for planning purposes. Additional treatments may be determined to be necessary on some sites and these will be addressed under project plans.

- Management goals are to provide sufficient habitat to encourage an increasing grizzly bear population and optimize timber growing potential.
- Prescribed burning may be used to maintain or restore the composition and structure of plant communities, or for hazard reduction. Wildfires will be confined, contained or controlled.

Management Area 20A:

26,411 Acres

-- Similar to MA 20 [*grizzly bear habitat*], except it is considered unsuitable for timber harvest.

- Vegetative management for bear foods will be accomplished with the use of fire and will be scheduled to optimize short and long-term habitat conditions for the grizzly bear.

Fire return frequency used in ecosystem burning will be similar to MA 11. Since a major portion of this MA is adjacent to MA 11, it will be considered under a fire management plan, which will allow natural ignitions to burn within prescribed conditions.

For planning purposes 50% of the area will be scheduled for planned ignition to assure that a portion of the type has a regular fire return. A strategy of contain and confine will be used on the unplanned ignitions.

Management Area 21:

41,303 Acres

-- Old growth timber stands are the primary objective.

- Based on the fact that these communities are characterized by decadent, multi-storied, fully stocked conditions plus a fuel loading of dead and down material in excess of 15 tons per acre, fire will be excluded, except at the time of conversion, which should occur at about stand age 240 years.

Since these sites are suitable, fire will be applied as part of site treatment and hazard reduction. Habitat Group 1 is an exception to this strategy since communities characterized by open savanna are desired.

These sites will be burned lightly every 10 to 40 years to remove needle litter, rough and young seedlings. Since these communities are characterized by multiple age classes, fire should be applied in a manner that provides for seedling establishment as needed while still maintaining a generally clean understory.



Photo from "Fire: The Story Behind the Force of Nature" by J. de Golia

Management Areas 22 & 23:

69,411 Acres

- The same as MA 18 [*big game winter forage/timber production*] except these areas also have a visual objective.
- This objective will generally not effect the use of fire, but will require coordination with the landscape architect. Visual concerns may affect the size and intensity of the proposed burn, resulting in a mosaic of stand densities.

Management Areas 24 & 25:

168,723 Acres

- The same as MA 16 [*production of forest products*] except these areas also have a visual objective.
- Coordination with the landscape architect will be required; otherwise, they will be treated the same as MA 16. Visual concerns may affect the size and intensity of the proposed burn, resulting in a mosaic of stand densities.

Management Area 26:

19,722 Acres

- Contains key or critical elk summer habitat found on moist sites such as wallows, mineral licks, seeps and trampled areas, and important forage units in close proximity that tend to concentrate animals in relatively small areas.

Habitat & Fire

Timber harvest may occur using long rotations normally about 240 years.

Inclusions of Habitat Groups 2 and 3 will generally not require treatment because of the limited size of the types.

The remaining habitat types will be treated as needed at stand conversion.

- Management goals are to maintain or improve elk habitat and provide other resource objectives as compatible with the above direction.
- Prescribed burning may be used to maintain or restore the composition and structure of plant communities or for hazard reduction. Wildfires will be confined, contained or controlled.

Management Area 27:

83,460 Acres

- Contains areas that are presently unsuitable economically for timber management and are generally not needed to meet other management objectives.
- In the Thompson River and Rock Creek Drainages it may be determined that vegetative management is needed for bighorn sheep; otherwise, this management area will not be considered for ecosystem burning during the next decade because of its low priority in relation to the other MAs on the forest.

Management Area 28:

25,010 Acres

- Contains the Rattlesnake National Recreation Area.
- Management direction for the use of fire will be similar to MA 11. The fire management strategy will be addressed in the management plan for the area.

APPENDIX B

FIRE MANAGEMENT ANALYSIS ZONES [FMAZ]

These groups were broken out on parent material types, biomass growth potential, soil sensitivity to equipment, potential for public problems, and elevational zones.

FMAZ-1 -

This group is comprised of broad valleys with varied alluvial riparian types and large acreages of Lake Missoula sediments. There is significant rural development on these areas. The habitats are dry and the slope range is 0 to 35 percent. This group has low fuel loadings.

FMAZ-2 -

This group is comprised of steep to very steep mountain sideslopes with very stable argillite and stable limestone parent materials. The habitats found on these landscapes are moderately dry to moist with slope ranges of 25 to 90 percent. The fuel loadings are moderate to moderately high.

FMAZ-3 -

This group is comprised of a combination of moderately steep to steep rolling glacial till moraines and rolling to very steep high elevation mountain ridges with varied parent material types which have had extensive glacial activity. Along the high, steep ridges the group includes extensive areas of rock outcrops. The habitats are moist and the slopes range from 10 to 100 percent but the moraine areas are on the more gentle slopes. This group has moderately high fuel loading except the shallow rocky areas.

FMAZ-4 -

This group is comprised of moderately steep to steep mountain lands with granitic, schist or volcanic parent materials. These landtypes are very sensitive to equipment use and are highly erosive. Habitats are moist to moderately dry and the slope range is 25 - 75 percent. This group has high fuel loadings.

FMAZ-5 -

This group is comprised of all roadless lands within the Forest with all types of parent material and all slope ranges. Habitats are dry to wet and the fuel loadings are low to high.

FMAZ-6 -

Forest Service land protected by others.

APPENDIX C

A Document Database System for **Managing Fire Effects Knowledge**

The Fire Effects Information System (FEIS) is a computerized knowledge processor of the document database type and is designed to store and provided easy user access to knowledge regarding the effects of fire on plant species, plant communities, and associated animal species. Essentially, FEIS contains mostly text-type information organized in an encyclopedic fashion (see example on following page.) Presently, the system's knowledge base includes fire effects and related biological, ecological, and management information for nearly 300 plant species in 34 forest and range ecosystems.

FEIS Access Through the Data General Network:

US Forest Service users or others with access to the Data General Forest Service network may enter FEIS through the Information Center. The quickest way to gain access to the Info Center is:

```
Hit "INTERUPT"    NL
7 "User Applications"  NL
Enter "INFO_CENTER" NL
NL
Choose "FEIS" from the menu
(If not present in the list, select option 9 and enter "FEIS")
```

The above process can also be started from the CEO Main Menu. From the CEO Main Menu select:

```
7 "Utilities"  NL
6 "User Applications"  NL
1 "Run"  LN
___ "Number of INFO_CENTER App"  NL
NL
Choose "FEIS" from the Menu
```

You may mail yourself a single file containing the species (one or several) you choose to save during a session in FEIS by using the MAIL option in the main menu that reappears after you exit FEIS. You may have the FEIS output file mailed directly to your CEO mailbox as a CEO document. It will appear as FEIS.OUTPUT. If you request several species in a single session, they will be combined together in one large file.

Information Provided by FEIS

PLANT SPECIES CATEGORY

Species name	Life form
Abbreviation	Federal legal status
Synonyms	Other status compiled by and date
Plant code (SCS list of scientific plant names)	Last revised by and date
Taxonomy	Authorship and citation

DISTRIBUTION & OCCURRENCE

General distribution
Ecosystems
States
Administrative units
BLM physiographic regions
Kuchler plant associations
SAF cover types
Habitat types and plant communities

VALUE & USE

Wood products value
Importance to livestock and wildlife
Palatability
Food value
Cover value
Value for rehabilitation of disturbed sites
Other uses and values
Management considerations

BOTANICAL & ECOLOGICAL CHARACTERISTICS

General botanical characteristics
Raunkiaer life form
Regeneration process
Site characteristics
Successional status
Seasonal development

FIRE ECOLOGY

Fire ecology or adaptations
Lyon-Stickney fire survival strategy

FIRE EFFECTS

Immediate fire effect on plant
Discussion & qualification of fire effect
Plant response to fire
Discussion & qualification of plant response
Fire management consideration

FIRE CASE STUDY

Case study name
Reference season-severity class
Study location
Preburn vegetation
Target species phenological state
Site description
Fire description
Fire effects on target species
Fire management implications

REFERENCES

References

APPENDIX D

THE FIRE GROUPS

Habitat types are arranged into "Fire Groups" based on the response of the tree species to fire and the roles these tree species take during successional stages. The forest habitat types of Montana are included in the following:

Fire Group Zero -

A heterogeneous collection of special habitats. On the Lolo National Forest, these sites exist as scree, forested rock, wet meadow, mountain grassland or grassy bald, aspen grove and alder glade. Group Zero sites will not burn readily under normal summertime conditions.

Fire Group One - (Not represented on the Lolo Forest)

Dry limber pine habitat types. These occur most often east of the Continental Divide in Montana.

Fire Group Two -

Warm, dry ponderosa pine habitat types. This group consists of open ponderosa pine stands with predominantly grass undergrowth, and dense mixed-age strands of ponderosa pine. These sites may exist as fire-maintained grasslands, and do not support Douglas-fir, except as "accidental" individuals.

Fire Group Three - (Not represented on the Lolo Forest)

Warm, moist ponderosa pine habitat types. These sites occur in eastern Montana.

Fire Group Four -

Warm, dry Douglas-fir habitat types. These areas exist in nature as fire-maintained ponderosa pine stands that develop Douglas-fir regeneration beneath the pine in the absence of disturbance.

Fire Group Five -

Cool, dry Douglas-fir habitat types. Douglas-fir is often the only conifer that occurs on these sites. In the absence of fire, dense Douglas-fir sapling understories may develop.

Fire Group Six -

Moist Douglas-fir habitat types. Douglas-fir often dominates all stages of succession on these sites even when subjected to periodic fire.

Fire Group Seven -

Cool habitat types usually dominated by lodgepole pine. This group includes stands in which fire maintains lodgepole pine as a dominant seral species as well as those in which lodgepole is a persistent dominant species.

Fire Group Eight -

Dry, lower subalpine habitat types. This is primarily an eastern Montana group, although it is represented on the Lolo.

continued

THE FIRE GROUPS Continued

Fire Group Nine -

Moist, lower subalpine habitat types. Fires are infrequent, but severe, with long-lasting effects. Spruce is usually a component of seral strands.

Fire Group Ten-

Cold, moist upper subalpine and timberline habitat types. This is a collection of high-elevation habitats in which fires are infrequent. Fires are often small in a real extent because of normally sparse fuels. Subalpine fir, spruce, whitebark pine, and subalpine larch are the predominant conifers.

Fire Group Eleven -

Moist grand fir, western red cedar, and western hemlock habitat types. These are generally moist habitats in which fires are infrequent but often severe. In Montana, they occur exclusively west of the Continental Divide.

****The reader should be cautioned that (as in all cases where an attempt has been made to impose order on the heterogeneity of nature) the Fire Groups defined here include a number of borderline cases. Differences in fire behavior and in successional patterns often depend on very small local changes in fuel, temperature, moisture, sunlight, topography, and seed availability. Thus it would be possible for stands that are key to the same habitat type to fall into different Fire Groups. A certain reliance is placed on the judgment of the land manager in evaluating the local conditions of any particular site. The groups defined here are intended as a general guide, not a definitive treatment.**

APPENDIX E

Prescribed Fire Techniques for Habitat Groups 0 & 5

Habitat Group 0:

Meadows - Fire should be applied to these areas as needed to maintain the natural integrity of the meadow or to stimulate the plant community by reduction of the dead plant material. In some cases, it may be determined appropriate to remove tree encroachment by cutting, if conditions are such that fire would not be feasible. Cold trailing rather than dug firelines should be used in fire control to reduce disturbance and lower the chance of invader species becoming established.

Mountain Grassland - Cold trailing rather than fireline construction should be employed to reduce disturbance and the chance of establishing noxious species.

Habitat Group 5

Recent studies of basal area thinnings to reduce tree stress and therefore bug-proof the stand show promise in lengthening the period of resistance and should be considered in the management strategy developed for these conditions.

Warm phase - Clearcutting and broadcast burning favor lodgepole pine and larch where present, while partial cutting, with burning, favors Douglas-fir. Partial cutting without fire tends to favor subalpine fir. Without mechanical disturbances, only minor changes occur in the understory. Beargrass and huckleberry will decrease, depending on the severity of the site, and pinegrass and sedges will increase. On the warmest sites, some seral shrubs such as willow may increase, but will not dominate the community as they do in Habitat Group 2. Snow depths generally preclude winter use by wildlife other than moose.

Cold phase - Clearcutting and/or burning will maintain lodgepole pine as will partial cutting with light underburning. Partial cutting without fire will favor subalpine fir, which can form a dense stand in the understory and overstory. Clearcutting without fire will tend to favor a mixed community of lodgepole pine and subalpine fir. Understories will be most effected by partial cutting, which will cause an increase in huckleberry coverage.

APPENDIX F

MA-HG Treatment Evaluation Criteria

Ecosystem Balance -

The overall objective of the Ecosystem Maintenance Burning Plan is to assure ecosystem balance. The rating was based on how effective the treatment was expected to be in reducing spruce budworm impact, species conversion, mistletoe infection, and in increasing nutrient cycling. On winter range areas, forage response is evaluated. In essential grizzly bear range, potential food response for bear is considered. The rating is expressed on a scale of 0 to 100 and given a weight of 1.0 in importance.

Treatment Need -

Using the ranking presented on the next page for MA-HG combinations, an expression of treatment need was developed. This rating attempted to rate the biological need for periodic fire and the importance of treatment in meeting MA goals. Scale is 0 to 100. Weight in importance is 0.9.

Economic Return -

This is an expression of the anticipated economic gain resulting from increased growth as a result of better nutrient cycling, reduced spruce budworm loss, reduced mistletoe loss, and maintenance of seral species. Values were developed for regulated timber areas only. On unregulated lands, no gain was included since it would not be captured. All values were discounted to the present and expressed in Present Net Value (PNV) per acre. Scale is 0 to 100. Weight is 0.7.

Cost Per Elk Year -

A calculation of the anticipated increase in forage was made for all treated acres that have value for winter range. The forage increase was converted to a potential number of elk which could be supported by the forage increase. Since this response was spread over time, the value was expressed as elk years. This value was then expressed in cost of the treatment per acre per elk year increase. The resultant values were converted to a 0 to 100 scale and given a weight of 0.7.

Treatment Effectiveness -

This expression was developed to provide a measure of the extent of treatment versus the total area available. The higher the value, the more effective the MA for big game forage production. The scale was converted to a 0 to 100 and given a weight of 0.5.

Other Big Game Enhancement -

This scale provides a measure of habitat improvement for grizzly bear, bighorn sheep and old growth species. Values are based on a scale of 1 to 10 which are converted to a 0 to 100 scale and given a weight of 0.7.

Cost Per Acre -

This value indicates the expected cost per acre for the prescribed treatment over the next 50 years. The higher the value the more expensive it will be to implement the treatment. Values are expressed in dollars per acre. They were converted to a 0 to 100 scale and given a weight of 0.3.

APPENDIX F

Ranking of MA-HG Combinations

in Meeting Ecosystem Fire Program Goals

MA	HG	Fire Treatment Level	Fire Return Period	EMB Score
19	2	2	30 years	329
9	2	1	30 years	326
18#	2	1	at age 50	310
19	4*	1	40 years	301
11**	2	1	35 years	299
19	1	3	30 years	298
20	4*	1	at age 50	296
20	2	1	at age 50	294
19	0	2	30 years	290
19	3	1	40 years	289
18	4*	1	at age 50	286
19	4	1	150 years	285
18	3	1	at age 50	271
9	4*	1	40 years	271
9	1	3	30 years	268
16###	2	1	at age 50	268
9	3	1	40 years	266
19	5	1	100 years	256
11	1	2	30 years	254
20A	4*	1	50 years	253
20A	3	1	50 years	252
9	0	2	30 years	251
16	4*	1	at age 50	233
20	3	1	at age 50	232
20A	5	1	100 years	231
20A	0	1	30 years	229
10	1	3	30 years	229
20A	2	1	30 years	225
20A	4	1	150 years	205
18	1	2	30 years	201
21	1	3	30 years	191
9	5	1	100 years	186
11	3	1	50 years	184
11	4*	1	50 years	179
11	5	1	100 years	173
16	3	1	at age 50	169
10	3	1	50 years	162
10	4*	1	50 years	159
10	5	1	100 years	136

includes MAs 22 and 23

includes MAs 17, 24 and 25

* the GF/Xete portion of the Habitat Group

** includes MA 28

APPENDIX F

Analysis of Alternatives

This section provides a breakdown of the analysis of each Management Area-Habitat Group (MA-HG) combination considered for Ecosystem Maintenance Burning (EMB). Because of variable budgets the various MA-HG combinations and various levels of management intensity for each were evaluated. The manager can then select the level of implementation that may be undertaken with the current budget level, but is able to add to the program if additional funding becomes available.

Seven factors were used to evaluate the importance of burning in each MA-HG combination. By using the Tradeoff Evaluation Procedure, the importance of the difference of a factor among MA-HG combinations could be expressed in relation to the difference of another factor. Factors were also given a weight in relation to their importance in meeting the objectives of the program. The weights of the factors can be changed to study the impact of changing the emphasis of the program.

1. Ecosystem Balance

The primary objective of the EMB Plan is to maintain ecosystem balance. Generally each MA-HG combination was treated at three different management intensity levels. A judgment of the effectiveness of the treatment was made for each combination and rated on a scale of 0 to 1. This is referred to as the raw score in Table 1. The lowest score was then subtracted from all scores to determine the relative difference among scores. This factor was given a weight of 1 as it was considered the primary goal of the program. The difference value was then expressed in relation to a 0 to 100 scale and is shown as the ranking score in Table 1. This factor helps differentiate the effectiveness of treatment levels on each MA-HG combination.

Ranking of MA-HG Combinations and Level by Ecosystem Balance

Table 1

MA	HG	L	Ecosystem Stability			MA	HG	L	Ecosystem Stability		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
19	2	1	1	.75	100	20A	4*	1	.9	.65	87
19	2	2	1	.75	100	20A	4*	2	.8	.55	73
19	2	3	.9	.65	87	20A	4*	3	.8	.55	73
19	3	1	1	.75	100	11**	3	1	.9	.65	87
19	3	2	.91	.65	87	11	3	2	.8	.55	73
19	3	3	.8	.55	73	11	3	3	.8	.55	73

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by Ecosystem Balance

Table 1 (Continued)

MA	HG	L	Ecosystem Stability			MA	HG	L	Ecosystem Stability		
			Raw Score	Diff. Score	Ranking Score				Raw Score	Diff. Score	Ranking Score
19	4*	1	1	.75	100	11	4*	1	.9	.65	87
19	4*	2	.9	.65	87	11	4*	2	.8	.55	73
19	4*	3	.8	.55	73	11	4*	3	.8	.55	73
19	1	1	1	.75	100	20A	5	1	1	.75	100
19	1	2	1	.75	100	20A	5	2	.55	.30	40
19	1	3	1	.75	100	20A	5	3	.25	.00	0
18#	2	1	1	.75	100	11	1	1	1	.75	100
18	2	2	1	.75	100	11	1	2	1	.75	100
18	2	3	1	.75	100	11	1	3	.9	.65	87
9	2	1	1	.75	100	20	3	1	1	.75	100
9	2	2	.95	.70	93	20	3	2	1	.75	100
9	2	3	.85	.60	80	20	3	3	NO TREATMENT		
19	0	1	1	.75	100	20	4*	1	1	.75	100
19	0	1	1	.75	100	20	4*	2	1	.75	100
19	0	3	.9	.65	87	20	4*	3	NO TREATMENT		
11	2	1	1	.75	100	9	5	1	1	.75	100
11	2	2	1	.75	100	9	5	2	.55	.30	40
11	2	3	.85	.60	80	9	5	3	.25	.00	0
19	4	1	1	.75	100	16##	3	1	1	.75	19
19	4	2	.85	.60	80	16	3	1	1	.75	100
19	4	3	.50	.25	33	16	3	1	NO TREATMENT		
18	3	1	1	.75	100	16	4*	1	1	.75	100
18	3	2	1	.75	100	16	4*	2	1	.75	100
18	4*	2	1	.75	100	10	3	1	.9	.65	87
18	4*	3	1	.75	100	10	3	2	.8	.55	73
18	4*	3	NO TREATMENT			10	3	3	.8	.55	73
18	1	1	1	.75	100	10	4*	1	.9	.65	87
18	1	2	1	.75	100	10	4*	2	.8	.55	73
18	1	3	NO TREATMENT			10	4*	3	.8	.55	73

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by Ecosystem Balance

Table 1 (Continued)

MA	HG	L	Ecosystem Stability			MA	HG	L	Ecosystem Stability		
			Raw Score	Diff. Score	Ranking Score				Raw Score	Diff. Score	Ranking Score
9	3	1	1	.75	100	20A	0	1	1	.75	100
9	3	2	.9	.65	87	20A	0	2	.9	.65	87
9	3	3	.8	.55	73	20A	0	3	.8	.55	73
9	4*	1	1	.75	100	11	5	1	1	.75	100
9	4*	2	.9	.65	87	11	5	2	.55	.30	40
9	4*	3	.8	.55	73	11	5	3	.25	.00	0
9	1	1	1	.75	100	9	0	1	1	.75	100
9	1	2	1	.75	100	9	0	2	1	.75	100
9	1	3	1	.75	100	9	0	3	.9	.65	87
19	5	1	1	.75	100	10	1	1	1	.75	100
19	5	2	.55	.30	40	10	1	2	1	.75	100
19	5	3	.25	.00	0	10	1	3	1	.75	100
20A	2	1	1	.75	100	21	1	1	1	.75	100
20A	2	2	.95	.70	93	21	1	2	1	.75	100
20A	2	3	.85	.60	80	21	1	3	1	.75	100
20	2	1	1	.75	100	10	5	1	1	.75	100
20	2	2	1	.75	100	10	5	2	.55	.30	40
20	2	3	1	.75	100	10	5	3	.25	.00	0
16	2	1	1	.75	100	20A	4	1	1	.75	100
16	2	2	1	.75	100	20A	4	2	.5	.25	33
16	2	3	1	.75	100	20A	4	3	NO TREATMENT		
20A	3	1	.9	.65	87						
20A	3	2	.8	.55	73						
20A	3	3	.8	.55	73						

* Represents the GF/Xete portion of the Habitat Group

** Includes MA 28

Includes MA 22 and 25

Includes MA 16,17, 24 and 25

APPENDIX F

Analysis of Alternatives (Continued)

2. Economic Return

On areas that are in the regulated timber base an analysis of the economic impact on increased growth as a result of the EMB plan was made. Growth increases are anticipated from better nutrient cycling, reduced spruce budworm loss, reduced mistletoe loss and maintenance of seral species. Nutrient loss impact was predicted to represent one percent of MAI for the average fire return period. Values for Mean Annual Increment (MAI) were taken from Pfister et al (1977) and the fire return periods from Davis et al (1980). Spruce budworm impact was computed at 14 percent volume gain for the Douglas-fir and grand fir volume on 50 percent of Habitat Group 2 and on 75 percent of the area in Habitat Groups 3 and 4. Mistletoe impact was computed at 16 percent volume gain for the Douglas-fir volume on 25 percent of Habitat Group 2. Species conversion gain was computed for the grand fir portion of Habitat Group 4 and based on an expected conversion to 90 percent grand fir and an increase of 10 percent in defect if stands are not treated. The cost of treatment was based on anticipated program costs for the Lolo Forest.

The above information was used to run the Timber Economic Analysis System (TEAS) model using a treated, untreated analysis. The difference in discounted sale value between the treatments is shown in Table 2 as the raw ranking. The difference represents the lowest value subtracted from all other values. The resulting value was expressed below where a difference of 0 to \$4 equals 0, \$5 equals 10, \$6 to \$10 equals 80, \$11 to \$40 equals 90, and \$40+ equals 100. This value was given a weight of .7 and is expressed in the scoring rank of Table 2.

Ranking of MA-HG Combinations and Level by Economic Return

Table 2

MA	HG	L	Economic Return			MA	HG	L	Economic Return		
			Raw	Diff.	Ranking				Raw	Diff.	Ranking
			Score		Score				Score		Score
19	2	1	0	5	7	20A	4*	1	0	5	7
19	2	2	0	5	7	20A	4*	2	0	5	7
19	2	3	0	5	7	20A	4*	3	0	5	7
19	3	1	0	5	7	11**	3	1	0	5	7
19	3	2	0	5	7	11	3	2	0	5	7
19	3	3	0	5	7	11	3	3	0	5	7
19	4*	1	0	5	7	11	4*	1	0	5	7
19	4*	2	0	5	7	11	4*	2	0	5	7
19	4*	3	0	5	7	11	4*	3	0	5	7
19	1	1	0	5	7	20A	5	1	0	5	7

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by Economic Return

Table 2 (Continued)

MA	HG	L	Economic Return			MA	HG	L	Economic Return		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
19	1	2	0	5	7	20A	5	2	0	5	7
19	1	3	0	5	7	20A	5	3	0	5	7
18#	2	1	42	47	70	11	1	1	0	5	7
18	2	2	42	47	70	11	1	3	0	5	7
18	2	3	42	47	70	11	1	3	0	5	7
9	2	1	0	5	7	20	3	1	-5	0	0
9	2	2	0	5	7	20	3	2	-5	0	0
9	2	3	0	5	7	20	3	3	NO TREATMENT		
19	0	1	0	5	7	20	4*	1	104	109	70
19	0	2	0	5	7	20	4*	2	104	109	70
19	0	3	0	5	7	20	4*	3	NO TREATMENT		
11	2	1	0	5	7	9	5	1	0	5	7
11	2	1	0	5	7	9	5	2	0	5	7
11	2	3	0	5	7	9	5	3	0	5	7
19	4	1	0	5	7	16##	3	1	-5	0	0
19	4	2	0	5	7	16	3	1	-5	0	0
19	4	3	0	5	7	16	3	1	NO TREATMENT		
18	3	1	9	14	63	16	4*	1	104	109	70
18	3	2	9	14	63	16	4*	2	104	109	70
18	3	3	NO TREATMENT			16	4*	3	NO TREATMENT		
18	4*	3	186	191	70	10	3	1	0	5	7
18	4*	2	186	191	70	10	3	2	0	5	7
18	4*	3	NO TREATMENT			10	3	3	0	5	7
18	1	1	0	5	7	10	4*	1	0	5	7
18	1	2	0	5	7	10	4*	2	0	5	7
18	1	36	NO TREATMENT			10	4*	2	0	5	7
9	3	1	0	5	7	20A	0	1	0	5	7
9	3	2	0	5	7	20A	0	2	0	5	7
9	3	3	0	5	7	20A	0	3	0	5	7

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by Economic Return

Table 2 (Continued)

MA	HG	L	Economic Return			MA	HG	L	Economic Return		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
9	4*	1	0	5	7	11	5	1	0	5	7
9	4*	2	0	5	7	11	5	2	0	5	7
9	4*	3	0	5	7	11	5	2	0	5	7
9	1	1	0	5	7	9	0	1	0	5	7
9	1	2	0	5	7	9	0	2	0	5	7
9	1	3	0	5	7	9	0	3	0	5	7
19	5	1	0	5	7	10	1	1	0	5	7
19	5	2	0	5	7	10	1	2	0	5	7
19	5	3	0	5	7	10	1	3	0	5	7
20A	2	1	0	5	7	21	1	1	0	5	7
20A	2	2	0	5	7	21	1	2	0	5	7
20A	2	3	0	5	7	21	1	3	0	5	7
20	2	1	18	123	63	10	5	1	0	5	7
20	2	2	18	123	63	10	5	2	0	5	7
20	2	3	18	123	63	10	5	3	0	5	7
16	2	1	18	123	63	20A	4	1	0	5	7
16	2	2	18	123	63	20A	4	2	0	5	7
16	2	3	18	123	63	20A	4	3	NO TREATMENT		
20A	3	1	0	5	7						
20A	3	2	0	5	7						
20A	3	3	0	5	7						

APPENDIX F

Analysis of Alternatives (Continued)

3. Cost Per Elk Year

A calculation of the anticipated increase in forage was made for all areas that contained winter range. Management areas such as MA 9 may contain areas of winter range and were included. If the project area in question does not have winter range values and they were shown in the ranking score, they should be adjusted and that portion of the score deleted. Forage response was based on tables prepared for the Lolo Forest Plan and expressed as an average 10 year increase in production over unburned areas. The duration of the forage increase varied by habitat group and ranged from 10 to 50 years. Potential increase in elk numbers was based on the assumption that they would use 50 percent of the forage during 6 months of the year. Using this approach it required an increase of 4,320 pounds to support one additional elk. The potential increase was calculated for each decade after treatment, summed and divided into the cost of the burn resulting in the cost per elk year which is shown in Table 3. Each value was subtracted from the highest cost for the difference. This value was then expressed on a scale of 0 to 100 and given a weight of .7 for the ranking score.

Ranking of MA-HG Combinations and Levels by Cost per Elk Year

Table 3

MA	HG	L	COST/ELK YEAR			MA	HG	L	COST/ELK YEAR		
			Raw	Diff.	Ranking				Raw	Diff.	Ranking
			Score		Score				Score		Score
19	2	1	.89	14.05	70	20A	4*	1	0	-14.94	0
19	2	2	.89	14.05	70	20A	4*	2	0	-14.94	0
19	2	3	.89	14.05	70	20A	4*	3	0	-14.94	0
19	3	1	2.78	12.16	61	11**	3	1	0	-14.94	0
19	3	2	2.78	12.16	61	11	3	2	0	-14.94	0
19	3	3	2.78	12.16	61	11	3	3	0	-14.94	0
19	4*	1	1.70	13.24	66	11	4*	1	0	-14.94	0
19	4*	2	1.70	13.24	66	11	4*	2	0	-14.94	0
19	4*	3	1.70	13.24	66	11	4*	3	0	-14.94	0
19	1	1	1.85	13.09	65	20A	5	1	0	-14.94	0
19	1	2	1.85	13.09	65	20A	5	2	0	-14.94	0
19	1	3	1.85	13.09	65	20A	5	3	0	-14.94	0
18#	2	1	13.39	1.55	8	11	1	1	3.08	11.86	59
18	2	2	13.39	1.55	8	11	1	2	3.08	11.86	59

continued

APPENDIX F

Ranking of MA-HG Combinations and Levels by Cost per Elk Year

Table 3 (Continued)

MA	HG	L	COST/ELK YEAR			MA	HG	L	COST/ELK YEAR		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
18	2	3	13.39	1.55	8	11	1	3	3.08	11.86	59
9	2	1	1.08	13.86	69	20	3	1	0	-14.94	0
9	2	2	1.08	13.86	69	20	3	2	0	-14.94	0
9	2	3	1.08	13.86	69	20	3	3	NO TREATMENT		
19	0	1	2.48	12.46	62	20	4*	1	0	0	0
19	0	2	2.48	12.46	62	20	4*	2	0	-14.94	0
19	0	3	2.48	12.46	62	20	4*	3	NO TREATMENT		
11	2	1	.99	13.95	70	9	5	1	0	-14.94	0
11	2	2	.99	13.95	70	9	5	2	0	-14.94	0
11	2	3	.99	13.95	70	9	5	3	0	-14.94	0
19	4	1	2.31	12.63	63	16##	3	1	0	-14.94	0
19	4	2	2.31	12.63	63	16	3	1	0	-14.94	0
19	4	3	2.31	12.63	63	16	3	1	NO TREATMENT		
18	3	1	14.94	0	0	16	4*	1	0	-14.94	0
18	3	2	14.94	0	0	16	4*	2	0	-14.94	0
18	3	3	NO TREATMENT			16	4*	3	NO TREATMENT		
18	4*	1	10.23	4.71	23	10	3	1	0	-14.94	0
18	4*	2	10.23	4.71	23	10	3	2	0	-14.94	0
18	4*	3	NO TREATMENT			10	3	3	0	-14.94	0
18	1	1	13.36	1.58	8	10	4*	1	0	-14.94	0
18	1	2	13.36	1.58	8	10	4*	2	0	-14.94	0
18	1	3	NO TREATMENT			10	4*	3	0	-14.94	0
9	3	1	3.20	11.74	58	20A	0	1	0	-14.94	0
9	3	2	3.20	11.74	58	20A	0	2	0	-14.94	0
9	3	3	3.20	11.74	58	20A	0	3	0	-14.94	0
9	4*	1	1.85	13.09	65	11	5	1	0	-14.94	0
9	4*	2	1.85	13.09	65	11	5	2	0	-14.94	0
9	4*	3	1.85	13.09	65	11	5	3	0	-14.94	0

continued

APPENDIX F

Ranking of MA-HG Combinations and Levels by Cost per Elk Year

Table 3 (Continued)

MA	HG	L	COST/ELK YEAR			MA	HG	L	COST/ELK YEAR		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
9	1	1	2.29	12.65	63	9	0	1	2.26	12.68	63
9	1	2	2.29	12.65	63	9	0	2	2.26	12.68	63
9	1	3	2.29	12.65	63	9	0	3	2.26	12.68	63
19	5	1	0	-14.94	0	10	1	1	2.99	11.95	60
19	5	2	0	-14.94	0	10	1	2	2.99	11.95	60
19	5	3	0	-14.94	0	10	1	3	2.99	11.95	60
20A	2	1	0	-14.94	0	21	1	1	7.65	7.29	36
20A	2	2	0	-14.94	0	21	1	2	7.65	7.29	36
20A	2	3	0	-14.94	0	21	1	3	7.65	7.29	36
20	2	1	0	-14.94	0	10	5	1	0	-14.94	0
20	2	2	0	-14.94	0	10	5	2	0	-14.94	0
20	2	3	0	-14.94	0	10	5	3	0	-14.94	0
16	2	1	0	-14.94	0	20A	4	1	0	-14.94	0
16	2	2	0	-14.94	0	20A	4	2	0	-14.94	0
16	2	3	0	-14.94	0	20A	4	3	0	-14.94	0
20A	3	1	0	-14.94	0						
20A	3	2	0	-14.94	0						
20A	3	3	0	-14.94	0						

APPENDIX F

Analysis of Alternatives (Continued)

4. Treatment Effectiveness

This expression was developed to provide a measure of the effectiveness of the treatment by level. The value was arrived at by dividing the elk year increase by the acres treated and is shown as the raw score. The lowest value was subtracted from each value to show the difference. A straight line was used for values of .01 to .24 and expressed on a 0-24 scale. Values between .25 and .34 were valued at 35, .35 to .44 equal 45 and .45+ equal 50. These scores were then used as the ranking score shown in table 4.

Ranking of MA-HG Combinations and Level by Treatment Effectiveness

Table 4

MA	HG	L	Elk Increase/AC Treat.			MA	HG	L	Elk Increase/AC Treat.		
			Raw	Diff.	Ranking				Raw	Diff.	Ranking
			Score		Score				Score		Score
19	2	1	.54	.54	50	20A	4*	1	0	0	0
19	2	2	.36	.36	45	20A	4*	2	0	0	0
19	2	3	.27	.27	35	20A	4*	3	0	0	0
19	3	1	.12	.12	11	11**	3	1	0	0	0
19	3	2	.10	.10	9	11	3	2	0	0	0
19	3	3	.08	.08	7	11	3	3	0	0	0
19	4*	1	.23	.23	21	11	4*	1	0	0	0
19	4*	2	.20	.20	19	11	4*	2	0	0	0
19	4*	3	.16	.16	15	11	4*	3	0	0	0
19	1	1	.25	.25	22	20A	5	1	0	0	0
19	1	2	.16	.16	15	20A	5	2	0	0	0
19	1	3	.12	.12	11	20A	5	3	0	0	0
18#	2	1	.16	.16	15	11	1	1	.09	.09	8
18	2	2	.16	.16	15	11	1	2	.06	.06	6
18	2	3	.16	.16	15	11	1	3	.04	.04	4
9	2	1	.36	.36	45	20	3	1	0	0	0
9	2	2	.31	.31	35	20	3	2	0	0	0
9	2	3	.23	.23	21	20	3	3	NO TREATMENT		

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by Treatment Effectiveness

Table 4 (Continued)

MA	HG	L	Elk Increase/AC Treat.			MA	HG	L	Elk Increase/AC Treat.		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
19	0	1	.08	.08	7	20	4*	1	0	0	0
19	0	2	.07	.07	6	20	4*	2	0	0	0
19	0	3	.06	.06	6	20	4*	3	NO TREATMENT		
11	2	1	.18	.18	17	9	5	1	0	0	0
11	2	2	.15	.15	14	9	5	2	0	0	0
11	2	3	.12	.12	11	9	5	3	0	0	0
19	4	1	.03	.03	3	16##	3	1	0	0	0
19	4	2	.02	.02	2	16	3	1	0	0	0
19	4	3	.02	.02	2	16	3	1	NO TREATMENT		
18	6	4	.12	.12	11	16	4*	1	0	0	0
18	3	2	.12	.12	11	16	4*	2	0	0	0
18	3	3	NO TREATMENT			16	4*	3	NO TREATMENT		
18	4*	1	.02	.02	2	10	3	1	0	0	0
18	4*	2	.02	.02	2	10	3	2	0	0	0
18	4*	3	NO TREATMENT			10	3	3	0	0	0
18	1	1	.04	.04	4	10	4*	1	0	0	0
18	1	2	.02	.02	2	10	4*	2	0	0	0
18	1	3	NO TREATMENT			10	4*	3	0	0	0
9	3	1	.12	.12	11	20A	0	1	0	0	0
9	3	2	.10	.10	9	20A	0	2	0	0	0
9	3	3	.08	.08	7	20A	0	3	0	0	0
9	4*	1	.23	.23	21	11	5	1	0	0	0
9	4*	2	.18	.18	17	11	5	2	0	0	0
9	4*	3	.15	.15	14	11	5	3	0	0	0
9	1	1	.24	.24	22	9	0	1	.25	.25	35
9	1	2	.16	.16	15	9	0	2	.17	.17	16
9	1	36	.125	.12	11	9	0	3	.06	.06	6
19	5	1	0	0	0	10	1	1	.09	.09	8
19	5	2	0	0	0	10	1	2	.08	.08	7
19	5	3	0	0	0	10	1	3	.06	.06	6

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by Treatment Effectiveness

Table 4 (Continued)

MA	HG	L	Elk Increase/ Raw Score	AC Treat. Diff. Ranking Score		MA	HG	L	Elk Increase/ Raw Score	AC Treat. Diff. Ranking Score	
20A	2	1	0	0	0	21	1	1	.06	.06	6
20A	2	2	0	0	0	21	1	2	.04	.04	4
20A	2	3	0	0	0	21	1	3	.01	.01	1
20	2	1	0	0	0	10	5	1	0	0	0
20	2	2	0	0	0	10	5	2	0	0	0
20	2	3	0	0	0	10	5	3	0	0	0
16	2	1	0	0	0	20A	4	1	0	0	0
16	2	2	0	0	0	20A	4	2	0	0	0
16	2	3	0	0	0	20A	4	3	NO TREATMENT		
20A	3	1	0	0	0						
20A	3	2	0	0	0						
20A	3	3	0	0	0						

APPENDIX F

Analysis of Alternatives (Continued)

5. ENHANCEMENT OF T&E AND OTHER BIG GAME

This factor provides a measure of habitat improvement for grizzly bear, bighorn sheep and old growth species. Values were assigned on a scale of 0 to 10 and are expressed as the raw score. The low score was subtracted from all scores to equal the difference. The resultant value was expressed on a scale of 0 to 100 and given a weight of .7 and is shown as the ranking score in Table 5.

Ranking of MA-HG Combinations and Level by Enhancement of T&E

Table 5

MA	HG	L	Elk Increase/AC Treat.			MA	HG	L	Elk Increase/AC Treat.		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
19	2	1	0	0	0	20A	4*	1	10	10	70
19	2	2	0	0	0	20A	4*	2	9	9	63
19	2	3	0	0	0	20A	4*	3	9	9	63
19	3	1	0	0	0	11**	3	1	0	0	0
19	3	2	0	0	0	11	3	2	0	0	0
19	3	3	0	0	0	11	3	3	0	0	0
19	4*	1	0	0	0	11	4*	1	0	0	0
19	4*	2	0	0	0	11	4*	2	0	0	0
19	4*	3	0	0	0	11	4*	3	0	0	0
19	1	1	0	0	0	20A	5	1	6	6	40
19	1	2	0	0	0	20A	5	2	4	4	30
19	1	3	0	0	0	20A	5	3	3	3	20
18#	2	1	0	0	0	11	1	1	0	0	0
18	2	2	0	0	0	11	1	2	0	0	0
18	2	3	0	0	0	11	1	3	0	0	0
9	2	1	0	0	0	20	3	1	9	9	60
9	2	25	0	0	0	20	3	2	9	9	60
9	2	3	0	0	0	20	3	3	NO TREATMENT		
19	0	1	0	0	0	20	4*	1	0	0	0
19	0	2	0	0	0	20	4*	2	0	0	0
19	0	3	0	0	0	20	4*	3	NO TREATMENT		

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by Enhancement of T&E

Table 5 (Continued)

MA	HG	L	Elk Increase/AC Treat.			MA	HG	L	Elk Increase/AC Treat.		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
11	2	1	0	0	0	9	5	1	0	0	0
11	2	2	0	0	0	9	5	2	0	0	0
11	2	3	0	0	0	9	5	3	0	0	0
19	4	1	0	0	0	16##	3	1	0	0	0
19	4	2	0	0	0	16	3	1	0	0	0
19	4	3	0	0	0	16	3	1	NO TREATMENT		
18	3	1	0	0	0	16	4*	1	0	0	0
18	3	2	0	0	0	16	4*	2	0	0	0
18	3	3	NO TREATMENT			16	4*	3	NO TREATMENT		
18	4*	1	0	0	0	10	3	1	0	0	0
18	4*	2	0	0	0	10	3	2	0	0	0
18	4*	3	NO TREATMENT			10	3	3	0	0	0
18	1	1	0	0	0	10	4*	1	0	0	0
18	1	2	0	0	0	10	4*	2	0	0	0
18	1	3	NO TREATMENT			10	4*	3	0	0	0
9	3	1	0	0	0	20A	0	1	7	7	50
9	3	2	0	0	0	20A	0	2	7	7	50
9	3	3	0	0	0	20A	0	3	7	7	50
9	4*	1	0	0	0	11	5	1	0	0	0
9	4*	2	0	0	0	11	5	2	0	0	0
9	4*	3	0	0	0	11	5	3	0	0	0
9	1	1	0	0	0	9	0	1	0	0	0
9	1	2	0	0	0	9	0	2	0	0	0
9	1	3	0	0	0	9	0	3	0	0	0
19	5	1	5	5	35	10	1	1	0	0	0
19	5	2	3	3	21	10	1	2	0	0	0
19	5	3	1	1	7	10	1	3	0	0	0
20A	2	1	3.5	3.5	25	21	1	1	2	2	14
20A	2	2	3.5	3.5	25	21	1	2	2	2	14
20A	2	3	3	3	22	21	1	3	2	2	14

APPENDIX F

Ranking of MA-HG Combinations and Level by Enhancement of T&E

Table 5 (Continued)

MA	HG	L	Elk Increase/AC Treat.			MA	HG	L	Elk Increase/AC Treat.		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
20	2	1	3.5	3.5	25	10	5	1	0	0	0
20	2	2	3.5	3.5	25	10	5	2	0	0	0
20	2	3	3.5	3.5	25	10	5	3	0	0	0
16	2	1	0	0	0	30A	5	2	20	20	70
16	2	2	0	0	0	20A	4	2	7	7	49
16	2	3	0	0	0	20A	4	3	NO TREATMENT		
20A	3	1	9	9	63						
20A	3	2	8	8	54						
20A	3	3	8	8	54						

APPENDIX F

Analysis of Alternatives (Continued)

6. Cost Per Acre

This value indicates the expected cost per acre to implement each treatment level for the next 50 years. A treatment may only cost \$5 to apply but may require a treatment every 10 years resulting in a cost per acre of \$50 over the planning period. This cost is shown as the raw score. The score is subtracted from the highest cost to express the difference. This value is then expressed on a scale of 0 to 100 and given a weight of .3. Resultant values are shown as the ranking score in Table 6.

Ranking of MA-HG Combinations and Level by 50-Year Cost per Acre

Table 6

MA	HG	L	50 Year Cost/Acre			MA	HG	L	50 Year Cost/Acre		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
19	2	1	24.00	19.00	15	20A	4*	1	25.60	17.40	14
19	2	2	22.00	21.00	17	20A	4*	3	21.33	21.67	17
19	2	3	12.00	31.00	25	20A	4*	3	21.33	21.67	17
19	3	1	17.00	26.00	21	11**	3	1	14.60	28.40	23
19	3	2	13.60	29.40	23	11	3	2	12.17	30.83	25
19	3	3	11.23	31.77	25	11	3	3	12.17	30.83	25
19	4*	1	20.75	22.25	18	11	4*	1	17.60	25.40	20
19	4*	2	16.60	26.40	21	11	4*	2	14.67	28.33	23
19	4*	3	13.83	29.17	23	11	4*	3	14.67	28.33	23
19	1	1	23.00	20.00	16	20A	5	1	12.80	30.20	24
19	1	2	15.33	27.67	22	20A	5	2	10.24	32.76	26
19	1	3	11.50	31.50	25	20A	5	3	8.53	34.47	28
18#	2	1	6.80	36.20	29	11	1	1	14.00	29.00	23
18	2	2	6.80	36.20	29	11	1	2	9.33	33.67	27
18	2	3	6.80	36.20	39	11	1	3	7.00	36.00	29
9	2	1	19.33	23.67	19	20	3	1	18.60	24.40	19
9	2	2	16.57	26.43	21	20	3	2	18.60	24.40	19
9	2	3	12.89	30.11	24	20	3	3	NO TREATMENT		
19	0	1	7.67	35.33	28	20	4*	1	26.60	16.40	13
19	0	2	6.57	36.43	29	20	4*	2	26.60	16.40	13

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by 50-Year Cost per Acre

Table 6 (Continued)

MA	HG	L	50 Year Cost/Acre			MA	HG	L	50 Year Cost/Acre		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
19	0	3	5.75	37.25	30	20	4*	3	NO TREATMENT		
11	2	1	17.67	25.33	20	9	5	1	10.80	32.20	26
11	2	2	15.14	27.86	22	9	5	2	8.64	34.36	27
11	2	3	11.78	31.22	25	9	5	3	7.20	35.80	29
19	4	1	7.20	35.80	29	16##	3	1	18.60	24.40	19
19	4	2	6.17	36.83	29	16	3	1	18.60	24.40	19
19	4	3	5.40	37.60	30	16	3	1	NO TREATMENT		
18	3	1	18.60	24.04	19	16	4*	1	26.60	16.40	13
18	3	2	18.60	24.40	19	16	4*	2	26.60	16.40	13
18	3	3	NO TREATMENT			16	4*	3	NO TREATMENT		
18	4*	1	26.60	16.40	13	10	3	1	15.60	27.40	22
18	4*	2	26.60	16.40	13	10	3	2	13.00	30.00	24
18	4*	3	NO TREATMENT			10	3	3	13.00	30.00	24
18	1	1	43.00	0.00	0	10	4*	1	18.60	24.40	19
18	1	2	28.67	14.33	11	10	4*	2	15.50	27.50	22
18	1	3	NO TREATMENT			10	4*	3	15.50	27.50	22
9	3	1	19.50	23.50	19	20A	0	1	9.33	33.67	27
9	3	2	15.60	27.40	22	20A	0	2	7.00	36.00	29
9	3	3	13.00	30.00	24	20A	0	3	5.36	37.40	30
9	4*	1	22.00	21.00	17	11	5	1	10.80	32.20	26
9	4*	2	17.60	25.40	20	11	5	2	8.64	34.36	27
9	4*	3	14.67	28.33	23	11	5	3	7.20	35.80	29
9	1	1	28.00	15.00	12	9	0	1	28.00	15.00	12
9	14	2	18.67	24.33	19	9	0	2	9.33	33.67	27
9	1	3	14.00	29.00	23	9	0	3	7.00	36.00	29
19	5	1	10.80	32.20	26	10	1	1	14.00	29.00	23
19	5	2	8.64	34.36	27	10	1	2	11.20	31.80	25
19	5	3	7.20	35.80	29	10	1	3	9.33	33.67	27

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by 50-Year Cost per Acre

Table 6 (Continued)

MA	HG	L	50 Year Cost/Acre			MA	HG	L	50 Year Cost/Acre		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
20A	2	1	36.00	7.00	6	21	1	1	28.00	15.00	12
20A	2	2	30.86	12.14	10	21	1	2	18.67	24.33	19
20A	2	3	24.00	19.00	15	21	1	3	9.33	33.67	27
20	2	1	13.60	29.40	23	10	5	1	10.80	32.250	26
20	2	2	16.60	29.40	23	10	5	2	8.64	34.36	27
20	2	3	16.60	29.40	23	10	5	3	7.20	35.80	29
16	2	1	13.60	29.40	23	20A	4	1	8.53	34.47	28
16	2	2	13.60	29.40	23	20A	4	2	6.40	36.60	29
16	2	3	13.60	29.40	23	20A	4	3	NO TREATMENT		
20A	3	1	14.60	29.40	23						
20A	3	2	12.17	30.83	25						
20A	3	3	12.17	30.83	25						

APPENDIX F

Analysis of Alternatives (Continued)

7. Treatment Need

Using the ranking developed for prioritizing the MA-HG combinations, an expression of treatment need was developed. Values ranged from 1 to 360 and represent the raw score. Each value was subtracted from the highest value for the difference and then expressed on a scale of 0 to 100. This factor was given a weight of .9 and are shown as the ranking score in Table 7.

Ranking of MA-HG Combinations and Level by Treatment Need

Table 7

MA	HG	L	Treatment Need			MA	HG	L	Treatment Need		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
19	2	1	1	359	90	20A	4*	1	60	300	75
19	2	2	1	359	90	20A	4*	2	60	300	75
19	2	3	1	359	90	20A	4*	3	60	300	75
19	3	1	5	355	89	11**	3	1	100	260	65
19	3	2	5	355	89	11	3	2	100	260	65
19	3	3	5	355	89	11	3	3	100	260	65
19	4*	1	5	355	89	11	4*	1	100	260	65
19	4*	2	5	355	89	11	4*	2	100	260	65
19	4*	3	5	355	89	11	4*	3	100	260	65
19	1	1	7	353	88	20A	5	1	120	240	60
19	1	2	7	353	88	20A	5	3	120	240	60
19	1	3	7	353	88	20A	5	3	120	240	60
18#	2	1	10	350	88	11	1	1	140	220	55
18	2	2	10	350	88	11	1	2	140	220	55
18	2	3	10	350	88	11	1	3	140	220	55
9	2	1	15	345	86	20	3	1	150	210	53
9	2	2	15	345	86	20	3	2	150	210	53
9	2	3	15	245	86	20	3	3	NO TREATMENT		
19	0	1	15	345	86	20	4*	1	150	210	53
19	0	2	15	345	86	20	4*	2	150	210	53
19	0	3	15	345	86	20	4*	3	NO TREATMENT		

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by Treatment Need

Table 7

MA	HG	L	Treatment Need			MA	HG	L	Treatment Need		
			Raw Score	Diff.	Ranking Score				Raw Score	Diff.	Ranking Score
11	2	1	20	340	85	9	5	1	150	210	53
11	2	2	20	340	85	9	5	2	150	210	53
11	2	3	20	340	85	9	5	3	150	210	53
19	4	1	30	330	83	16##	3	1	160	200	50
19	4	2	30	330	83	16	3	1	160	200	50
19	4	3	30	330	83	16	3	1	NO TREATMENT		
18	3	1	50	310	78	16	4*	1	160	200	50
18	3	2	50	310	78	16	4*	2	160	200	50
18	3	3	NO TREATMENT			16	4*	3	NO TREATMENT		
18	4*	1	50	310	78	10	3	1	175	185	46
18	4*	2	50	310	78	10	3	2	175	185	46
18	4*	3	NO TREATMENT			10	3	3	175	185	46
18	1	1	70	290	73	10	4*	1	175	185	46
18	1	2	70	290	73	10	4*	2	175	185	46
18	1	3	NO TREATMENT			10	4*	3	175	185	46
9	3	1	75	285	71	20A	0	1	180	180	45
9	3	2	75	285	71	20A	0	2	180	180	45
9	3	3	75	285	71	20A	0	3	180	180	45
9	4*	1	75	285	71	11	5	1	200	160	40
9	4*	2	75	285	71	11	5	2	200	160	40
9	4*	3	75	285	71	11	5	3	200	160	40
9	14	1	105	255	64	9	0	1	225	135	34
9	1	2	105	255	64	9	0	2	225	135	34
9	1	3	105	255	64	9	0	3	225	135	34
19	5	1	10	350	88	10	1	1	245	115	29
19	5	2	10	350	88	10	1	2	245	115	29
19	5	3	10	350	88	10	1	3	245	115	29
20A	2	1	12	348	87	21	1	1	336	24	6
20A	2	2	12	348	87	21	1	2	336	24	6

continued

APPENDIX F

Ranking of MA-HG Combinations and Level by Treatment Need

Table 7 (Continued)

MA	HG	L	Treatment Need			MA	HG	L	Treatment Need		
			Raw	Diff.	Ranking				Raw	Diff.	Ranking
			Score		Score				Score		Score
20A	2	3	12	348	87	21	1	3	336	24	6
20	2	1	30	330	83	10	5	1	350	10	3
20	2	2	30	330	83	10	5	3	350	10	3
20	2	3	30	330	83	10	5	3	350	10	3
16	2	1	32	328	82	20A	4	1	360	0	0
16	2	2	32	328	82	20A	4	2	360	0	0
16	2	3	32	328	82	20A	4	3	NO TREATMENT		
20A	3	1	60	300	75						
20A	3	2	60	300	75						
20A	3	3	60	300	75						

APPENDIX F

Analysis of Alternatives (Continued)

8. Ranking by MA-HG Combination and Level

Table 8 provides a list of the total ranking score for each MA-HG combination by management intensity level. The MA-HG combination with the highest score represents the highest priority area for treatment on the Lolo Forest. The treatment level within the MA-HG combination with the highest score represents the best treatment level. In cases where the values are within a few points, selecting the lower treatment level will be advantageous from a cost standpoint without much impact on expected gains.

Total of Ranking Scores for MA-HG Combinations and Levels

Table 8

MA HG L EMT SCORE	MA HG L EMT SCORE	MA HG L EMT SCORE
19 2 1 331	9 4* 1 271	20 4* 1 306
19 2 2 329	9 4* 2 267	20 4* 2 306
19 2 3 314	9 4* 3 253	20 4* 3 NT
19 3 1 289	9 1 1 268	9 5 1 186
19 3 2 276	9 1 2 268	9 5 2 157
19 3 3 260	9 1 3 268	9 5 3 89
19 4* 1 301	19 5 1 256	16 3 1 169
19 4* 2 289	19 5 2 183	16 3 1 169
19 4* 3 273	19 5 3 131	16 3 1 NT
19 1 1 298	20A 2 1 225	16 4* 1 233
19 1 2 297	20A 2 2 222	16 4* 2 233
19 1 3 296	20A 2 3 207	16 4* 3 NT
18 2 1 310	20 2 1 294	10 3 1 162
18 2 2 310	20 2 2 294	10 3 2 150
18 2 3 310	20 2 3 294	10 3 3 150
9 2 1 326	16 2 1 268	10 4* 1 159

continued

APPENDIX F

Total of Ranking Scores for MA-HG Combinations and Levels

Table 8 (Continued)

MA	HG	L	EMT SCORE	MA	HG	L	EMT SCORE	MA	HG	L	EMT SCORE
	9	2	2	311	16	2	2	268	10	4*	2 148
9	2	3	287	16	2	3	268	10	4*	3	148
19	0	1	290	20A	3	1	252	20A	0	1	229
19	0	2	290	20A	3	2	234	20A	0	2	218
19	0	3	278	20A	3	3	234	20A	0	3	215
11	2	1	299	20A	4*	1	253	11	5	1	173
11	2	2	298	20A	4*	2	235	11	5	2	114
11	2	3	278	20A	4*	3	235	11	5	3	76
19	4	1	285	11	3	1	182	9	0	1	251
19	4	2	264	11	3	2	170	9	0	2	247
19	4	3	218	11	3	3	170	9	0	3	226
18	3	1	271	11	4*	1	179	10	1	1	227
18	3	2	271	11	4*	2	168	10	1	2	228
18	3	3	NT	11	4*	3	1468	10	1	3	229
18	4*	1	286	20A	5	1	231	21	1	1	181
18	4*	2	286	20A	5	2	163	21	1	2	186
18	4*	3	NT	20A	5	3	115	21	1	3	191
18	1	1	192	11	1	1	252	10	5	1	136
18	1	2	201	11	1	2	254	10	5	2	77
18	1	3	NT	11	1	3	241	10	5	3	39
9	3	1	266	20	3	1	232	20A	4	1	205
9	3	2	254	20	3	2	232	20A	4	2	118
9	3	3	240	20	3	3	NT	20A	4	3	NT

APPENDIX F

BURNING FREQUENCY LEVELS

Acreages and burning frequency levels for the Lolo's Management Area-Habitat Group (MA-HG) combinations are presented in the tables below. They include the anticipated program for each Ranger District, as well as the fire return interval anticipated under each level of treatment, and the method for determining acres in need of treatment. The total acres of each MA-HG combination, its age structure, species composition and the percent of a habitat type found in each group came from the Forest Plan Data Base.

LEVEL 3 (Fully Implemented Program)

This level represents an optimum frequency of fire application for ecosystem balance and for meeting Management Area goals.

Acres Per Year by MA and HG (Level 3 Burning Frequency - Continued)					
MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
19	2	27173		20 years	1359
19	3	8350		40 years	209
19	4*	3438	21.5% of HG is GF/Xete = 730 ac.	40 years	18
19	1	16709	96% grass type = 16041 4% shrub type = 668	10 years 25 years	1631
18	2	124060	2.1% of HG is in seedling/sapling age	at age 30	260
22-23					
19	5	1803		100 years	18
20A	2	2537	50% by Natural Ignition	30 years	42
9	2	7007		30 years	234
19	0	24815	(includes 10-0 acres)	30 years	827
11	2	10847	50% by Natural Ignition	30 years	181
28	2	2047	50% by Natural Ignition	30 years	34
19	4	3438	HG - GF/Xete ac.		
			50% by Natural Ignition	150 years	9
20	2	8016	12.2% of HG = poles	at age 50	98
16-17	2	144730	12.2% of HG = poles		
24-25				at age 50	1766
continued					

APPENDIX F

Acres Per Year by MA and HG (Level 3 Burning Frequency - Continued)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
21	2	10984	none needed	at conversion	0
26	2	369	minor inclusions	at conversion	0
18	3	22749	10.96% of HG = poles		
22-23				at age 50	249
18	4*	9072	21.5% of HG = GF/Xete		
22-23			5% = poles	at age 50	10
20A	3	1796	50% Natural Ignition	50 years	18
20A	4*	6196	21.5% of HG = GF/Xete		
			50% Natural ignition	50 years	13
18	1	16752	96% grass type = 16082	10 years	
22-23			4% shrub type = 670	25 years	1072
9	3	2348		40 years	59
9	4*	1512	21.5% of HG = GF/Xete	40 years	8
18	5	2159			
22-23			none needed	at conversion	0
11	3	18378	50% Natural Ignition	50 years	184
28	3	2635	50% Natural Ignition	50 years	26
11	4*	35886	21.5% of HG = GF/Xete	50 years	77
			50% Natural Ignition		
28	4*	2652	21.5% of HG = GF/Xete	50 years	6
			50% Natural Ignition		
9	1	1001	96% grass type = 961	10 years	
			4% shrub type = 40	25 years	98
20A	5	6424	50% Natural Ignition	100 years	32
11	1	771	96% grass type = 740	20 years	
			4% shrub type = 31	25 years	19
			50% Natural Ignition		
28	1	296	96% grass type = 284	20 years	
			4% shrub type = 12	25 years	7
			50% Natural Ignition		

continued

APPENDIX F

Acres Per Year by MA and HG (Level 3 Burning Frequency - Continued)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
20	3	6725	10.96% of HG = poles	at age 50	74
20	4*	27498	21.5% of HG = GF/Xete	at age 50	
			5% of HG = poles		30
9	5	2107		100 years	21
16-17	3	211278	10.96% of HG = poles	at age 50	
24-25					2316
16-17	4*	352802	21.5% of HG = Gf/Xete	at age 50	
24-25			5% of HG = poles		379
10	3	425		50 years	8
10	4*	948	21.5% of HG = GF/Xete	50 years	4
20A	0	3100	50% Natural Ignition (includes 20-0)	30 years	52
1	3	211	small inclusions	none scheduled	0
11	5	36287	50% Natural Ignition	100 years	181
28	5	2411	50% Natural Ignition	100 years	12
16-17	1	3906	none required	30 years	0
24-25					
9	0	2164		10 years	216
21	3	7242	none required	at conversion	0
10	1	652		20 years	32
26	3	819	small inclusions	at conversion	0
11	0	383014	none scheduled		0
28	0	1588	none scheduled		0
18	4	9072			
22-23			none required	at conversion	0
20	5	27061	none required	at conversion	0
16-17	5	152194	none required	at conversion	0
24-25					

continued

APPENDIX F

Acres Per Year by MA and HG (Level 3 Burning Frequency - Continued)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
21	1	487		10 years	41
10	5	487		100 years	5
20A	4	6196	6196 - GF/Xete - 4864 50% Natural Ignition	150 years	16
TOTAL					<hr/> 11951 (12000)

APPENDIX F

BURNING FREQUENCY LEVELS (Continued)

Interim Stairstep Level for FY 96

Program costs are significantly higher than what the Lolo Forest historically has received for this type of program. Based on present budget limitations, it still appears realistic to accomplish this level of treatment.

Acres by District and MA-HG Combination for Proposed Ecosystem Fire Program

MA - HG		DISTRICT					TOTAL
		Missoula	Ninemile	Plains	Seeley Lake	Superior	
19	2	15	265	324	0	75	679
19	3	3	56	70	0	10	12
19	1	262	190	95	0	272	819
18							
22-23	2	31	70	44	3	112	260
19	5	0	3	7	0	4	12
20A	2	0	0	28	0	0	28
9	2	130	4	0	22	0	156
28	2	23	0	0	0	0	23
11	2	19	25	16	12	49	121
19	4	0	1	4	0	2	7
20	2	0	0	45	53	0	98
16-17							
24-25	2	413	442	355	204	352	1766
21	2	0	0	0	0	0	0
26	2	0	0	0	0	0	0
18							
22-23	3	0	0	0	0	0	0
18							
22-23	4*	0	0	0	0	0	0
20A	3	0	0	18	0	0	18
20A	4*	0	0	6	5	0	11
18							
22-23	1	0	0	0	0	0	0
9	3	28	0	0	11	0	39
9	4*	0	0	1	0	4	5
18							

continued

APPENDIX F

Acres by District and MA-HG Combination-FY 96 for Proposed Ecosystem Fire Program (Continued)

MA - HG		DISTRICT					TOTAL
		Missoula	Ninemile	Plains	Seeley Lake	Superior	
22-23	5	0	0	0	0	0	0
28	3	22	0	0	0	0	22
II	3	58	42	12	15	26	153
28	4*	5	0	0	0	0	5
II	4*	11	12	21	7	13	64
9	I	39	8	2	0	0	49
20A	5	0	0	11	10	0	21
28	I	4	0	0	0	0	4
II	I	7	0	0	1	2	10
20	3	0	0	0	0	0	0
20	4*	0	0	0	0	0	0
9	5	2	0	0	1	11	14
16-17							
24-25	3	0	0	0	0	0	0
16-17							
24-25	4*	0	0	0	0	0	0
10	3	0	0	7	0	0	7
10	4*	0	1	2	0	0	3
20A	0	0	0	27	4	0	31
I	3	0	0	0	0	0	0
28	5	8	0	0	0	0	8
II	5	26	30	32	21	12	121
16-17							
24-25	I	0	0	0	0	0	0
9	0	23	3	0	5	23	54
21	3	0	0	0	0	0	0
10	I	11	0	11	0	0	22
26	3	0	0	0	0	0	0
28	0	0	0	0	0	0	0
II	0	0	0	0	0	0	0
18							
22-23	4	0	0	0	0	0	0
20	5	0	0	0	0	0	0
16-17							
24-25	5	0	0	0	0	0	0
21	I	5	3	0	0	0	8
10	5	0	2	1	0	0	3
20A	4*	0	0	0	0	0	0
Total		1348	117	1444	374	1073	5520 (6000)

* Represents the GF/Xete portion of Habitat Group (21.5%) which will be treated the same as HG 3.

APPENDIX F

BURNING FREQUENCY LEVELS (Continued)

Interim Stairstep Level for FY 96

Acres Per Year by MA and HG

(FY 96 Burning Frequency)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
19	2	27173		40 years	679
19	3	8350		60 years	139
19	4*	3438	21.5% of HG = GF/Xete = 739 ac.	60 years	12
19	1	16709	96% grass type = 16041	20 years	
			4% shrub type = 668	40 years	819
18	2	124060	2.1% of HG is		
22-23			seedling & sapling	at age 30	260
19	5	1803		150 years	12
20A	2	2537	50% by Natural Ignition	45 years	28
9	2	7007		45 years	156
19	0	24815	(includes 18 0 acres)	40 years	620
28	2	2047	50% by Natural Ignition	45 years	23
11	2	10847	50% by Natural Ignition	45 years	121
19	4	3438	3438 - GF/Xete		
			50% by Natural Ignition	200 years	7
20	2	8016	12.2% = poles	at age 50	98
16-17	2	144730	12.2% = poles		
24-25				at age 50	1766
21	2	10984	none needed	at conversion	0
26	2	369	minor inclusions	at conversion	0
18	3	22749	10.96% = poles		
22-23				at conversion	0
18	4	9072	21.5% of HG-GF/Xete = 1950		
22-23				at conversion	0

continued

APPENDIX F

Acres Per Year by MA and HG (FY 96 Burning Frequency - continued)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
20A	3	1796	50% by Natural Ignition	60 years	1
20A	4*	9072	21.5% of HG = GF/Xete		
			50% by Natural Ignition	60 years	11
18	1	16752	96% grass type = 16082	30 years	
22-23			4% shrub type = 670	30 years	0
9	3	2348		60 years	39
9	4*	1512	21.5% of HG = GF/Xete	60 years	5
18	5	2159	none needed		
22-23				at conversion	0
28	3	2635	50% by Natural Ignition	60 years	22
11	3	18378	50% by Natural Ignition	60 years	153
28	4*	2625	21.5% of HG = GF/Xete	60 years	5
			50% by Natural Ignition		
11	4*	35886	21.5% of HG = GF/Xete	60 years	64
			50% by Natural Ignition		
9	1	1001	96% grass type = 961	20 years	
			4% shrub type = 40	40 years	49
20A	5	6424	50% by Natural Ignition	150 years	21
11	1	771	96% grass type = 740	40 years	
			4% shrub type = 31	40 years	10
			40% by Natural Ignition		
28	1	296	96% grass type = 284	40 years	
			4% shrub type = 12	40 years	4
			50 % by Natural Ignition		
20	3	6725	10.96% = poles	at conversion	0
20	4*	27498	21.5% of HG GF/Xete	at conversion	
			5% = poles		
9	5	2107		150 years	14

continued

Acres Per Year by MA and HG
(FY 96 Burning Frequency - continued)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
16-17 24-25	3	211278	10.96% = poles	at conversion	0
16-17 24-25	4*	352802	21.5% of HG GF/Xete 5% = poles	at conversion	
10	3	425		60 years	7
10	4*	948	21.5% of HG = GF/Xete	60 years	3
20A	0	3100	50% Natural Ignition (Includes 20-0)	50 years	31
1	3	211	small inclusions	none scheduled	0
28	5	2411	50% Natural Ignition	150 years	8
11	5	36287	50% Natural Ignition	150 years	121
16-17 24-25	1	3906	none required	30 years	0
9	0	2164		40 years	54
21	3	7242	none required	at conversion	0
10	1	652		30 years	22
26	3	819	small inclusions	at conversion	0
28	0	1588	none scheduled		0
11	0	38301	none scheduled		0
18	4	9072	9072 - GF/Xete = 7122		
22-23			none required	at conversion	0
20	5	27061	none required	at conversion	0
17-17 24-25	5	152194	none required	at conversion	0
10	5	487		150 years	3
20A	4	6196	6196 - GF/Xete = 4864 50% Natural Ignition	not treated	0
TOTAL					5412

APPENDIX F

BURNING FREQUENCY LEVELS (Continued)

Interim Stairstep Level for FY 97

Acres by District and MA-HG Combination for Proposed Ecosystem Fire Program

MA - HG		DISTRICT					TOTAL
		Missoula	Ninemile	Plains	Seeley Lake	Superior	
19	2	21	353	432	0	100	906
19	3	4	68	83	0	12	167
19	4*	0	1	9	0	5	15
19	1	349	253	126	0	363	1091
18							
22-23	2	31	70	44	3	112	260
19	5	0	3	8	0	3	14
20A	2	0	0	36	0	0	36
9	2	166	5	0	29	0	200
19	0	233	17	341	0	118	709
28	2	29	0	0	0	0	29
11	2	25	33	20	15	62	155
19	4	0	1	4	0	2	7
20	2	0	0	45	53	0	98
16-17							
24-25	2	413	442	355	204	352	1766
21	2	0	0	0	0	0	0
26	2	0	0	0	0	0	0
18							
22-23	3	24	57	76	10	82	249
18							
22-23	4*	0	3	3	0	4	10
20A	3	0	0	18	0	0	18
20A	4*	0	0	6	5	0	11
18							
22-23	1	116	220	63	0	137	536
9	3	33	0	0	14	0	47
9	4*	0	0	1	0	5	6
18							
22-23	5	0	0	0	0	0	0
28	3	22	0	0	0	0	22
11	3	58	42	12	15	26	153

continued

APPENDIX F

Acres by District and MA-HG Combination- FY 97 for Proposed Ecosystem Fire Program (Continued)

MA - HG		DISTRICT					TOTAL
		Missoula	Ninemile	Plains	Seeley Lake	Superior	
28	4*	5	0	0	0	0	5
11	4*	11	12	21	7	13	64
9	1	52	10	3	0	0	65
20A	5	0	0	14	12	0	26
28	1	5	0	0	0	0	5
11	1	9	1	0	1	2	13
20	3	0	0	43	31	0	74
20	4*	0	0	18	12	0	30
9	5	2	0	0	2	13	17
16-17							
24-25	3	645	416	690	205	360	2316
16-17							
24-25	4*	23	50	125	15	166	379
10	3	0	0	7	0	0	7
10	4*	0	2	0	0	3	5
20A	0	0	0	33	6	0	39
1	3	0	0	0	0	0	0
28	5	10	0	0	0	0	10
11	5	31	36	38	25	15	145
16-17							
24-25	1	0	0	0	0	0	0
9	0	30	4	0	7	31	72
21	3	0	0	0	0	0	0
10	1	13	0	13	0	0	26
26	3	0	0	0	0	0	0
28	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
18							
22-23	4	0	0	0	0	0	0
20	5	0	0	0	0	0	0
16-17							
24-25	5	0	0	0	0	0	0
21	1	16	8	0	0	0	24
10	5	0	3	1	0	0	4
20A	4*	0	0	7	5	0	12
Total		2376	2109	2697	676	1983	9841 (10000)

* Represents the GF/Xete portion of the Habitat Group (21.5%) which will be treated the same as HG 3.

APPENDIX F

BURNING FREQUENCY LEVELS (Continued)

Interim Stairstep Level for FY 97

Acres Per Year by MA and HG (FY97 Burning Frequency)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
22-23			none required	at conversion	0
19	2	27173		30 years	906
19	3	8350		50 years	1467
19	4*	3438	21.5% of HG GG/Xete = 739 acres	50 years	15
19	1	16709	96% grass type = 16041 4% shrub type = 668	15 years 30 years	 1091
18	2	124060	2.1% of HG is		
22-23			seedling & sapling	at age 30	260
19	5	1803		125 years	14
20A	5	2537	50% Natural Ignition	35 years	36
9	2	7007		35 eyars	200
19	0	24815	(includes 18-0 ac)	35 years	719
28	2	2047	50% Natural Ignition	356 years	29
11	2	10847	50% Natural Ignition	35 years	155
19	4	3438	3438 - GF/Xete		
			50% Natural Ignition	175 years	7
20	2	8016	12.2% of HG = poles	at age 50	98
16-17	2	144730	12.2% of HG = poles		
24-25				at age 50	1766
21	2	10984	none needed	at conversion	0
26	2	369	minor inclusions	at conversion	0

continued

APPENDIX F

Acres Per Year by MA and HG (FY97 Burning Frequency - Continued)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
18	3	22749	10.96% of HG = poles		
22-23				at age 50	249
18	4*	9072	21.5% of HG = GF/Xete		
22-23			5% = poles	at age 50	10
20A	3	1796	50% Natural Ignition	60 years	18
20A	4*	9072	21.5% of HG = GF/Xete		
			50% Natural Ignition	60 years	11
18	1	16752	96% grass type = 16082	15 years	
22-23			4% shrub type = 670	25 years	536
9	3	2348		50 years	47
9	4*	1512	12.5% of HG - GF/Xete	50 years	6
18	5	2159	none needed		
22-23				at conversion	0
28	3	2635	50% Natural Ignition	60 years	22
11	3	18378	50% Natural Ignition	60 years	153
28	4*	2625	21.5% of HG = HG/Xete	60 years	5
			50% Natural Ignition		
11*	4*	35886	21.5% of HG = GF/Xete	60 years	64
			50% Natural Ignition		
9	1	1001	96% grass type = 961	15 years	
			4% shrub type = 40	30 years	65
20A	5	6424	50% Natural Ignition	125 years	26
11	1	771	96% grass type = 740	30 years	
			4% shrub type = 31	30 years	13
			50% Natural Ignition		
28	1	296	96% grass type = 284	30 years	
			4% shrub type = 12	30 years	5
			50% Natural Ignition		

continued

APPENDIX F

Acres Per Year by MA and HG (FY97 Burning Frequency - Continued)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
20	3	6725	10.96% of HG = poles	at age 50	74
20	4*	27498	21.5% of HG = GF/Xete	at age 50	
			5% = poles		30
9	5	2107		125 years	17
19-17	3	211278	10.96% = poles	at age 50	
24-25					2316
16-17	4*	352802	21.5% of HG = GF/Xete	at age 50	
24-25			5% = poles		379
10	3	425		60 years	7
10	4*	948	21.5% of HG = GF/Xete	60 years	3
20A	0	3100	50% Natural Ignition		
			(includes 20-0)	40 years	39
1	3	211	small inclusions	none scheduled	0
28	5	2411	50% Natural Ignition	125 years	10
11	5	36287	50% Natural Ignition	125 years	145
16-17	1	3906	none required	30 years	0
24-25					
9	0	2164		30 years	72
21	3	7242	none required	at conversion	0
10	1	652		25 years	26
26	3	819	small inclusions	at conversion	0
28	0	1588	none scheduled		0
11	0	38301	none scheduled		0
18	4	9072	9072 - GF/Xete = 7122		
22-23			none required	at conversion	0
20	5	27061	none required	at conversion	0

continued

APPENDIX F

Acres Per Year by MA and HG (FY97 Burning Frequency - Continued)

MA	HG	Acres	Acre Adjustments	Fire Return Interval	First Decade Acres/year
16-17 24-25	5	152194	none required	at conversion	0
21	1	487		15 years	24
10	5	487		125 years	4
20A	4	6196	6196 - GF/Xete = 4864 50% Natural Ignition	200 years	12
TOTAL					<div style="border-top: 1px solid black; display: inline-block; width: 100px; text-align: right;">9841</div> <div style="display: inline-block; width: 100px; text-align: right;">(10000)</div>

APPENDIX G

Program Planning and Evaluation

for Ecosystem Fire Program

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
EMB ID Team Input Analysis	\$2,000	\$2080	\$2164	\$2251	\$2341	\$2435	\$2557	\$2659	\$2765	\$2876
Development of Dist. EMB Environmental Analysis for 2-year program	\$1500	\$1560	\$1622	\$1687	\$1754	\$1824	\$1897	\$1973	\$2052	\$2134
Burn Plan Develop.	\$500	\$520	\$541	\$563	\$586	\$609	\$633	\$658	\$684	\$711
Program Monitoring and Evaluation Costs	\$250	\$260	\$270	\$281	\$292	\$304	\$316	\$329	\$342	\$356
Interagency/Cooperator Coordination and Public Involvement	\$1200	\$1248	\$1298	\$1350	\$1404	\$1460	\$1518	\$1579	\$1642	\$1708

Burn Preparation Costs

for Ecosystem Fire Program

Preparatory Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Machine Firelines Light Fuels	\$8.00	\$8.50	\$9.00	\$9.50	\$10.00	\$10.50	\$11.00	\$11.50	\$12.00	\$12.50
Machine Firelines Mod. Fuels	\$10.00	\$10.50	\$11.00	\$11.50	\$12.00	\$12.50	\$13.00	\$13.50	\$14.00	\$14.50
Machine Firelines Hvy Fuels	\$20.00	\$21.00	\$22.00	\$23.00	\$24.00	\$25.00	\$26.00	\$27.00	\$28.00	\$29.00
Hand Firelines Light Fuels	\$35.00	\$37.00	\$39.00	\$41.00	\$43.00	\$45.00	\$47.00	\$49.00	\$51.00	\$53.00
Hand Firelines Moderate Fuels	\$45.00	\$47.00	\$49.00	\$51.00	\$54.00	\$57.00	\$60.00	\$63.00	\$66.00	\$69.00
Hand Firelines Heavy Fuels	\$65.00	\$68.00	\$71.00	\$75.00	\$79.00	\$83.00	\$87.00	\$91.00	\$96.00	\$101.00
Fireline Explosives Lt. Fuels	\$60.00	\$63.00	\$66.00	\$69.00	\$72.00	\$76.00	\$80.00	\$84.00	\$88.00	\$92.00
Fireline Explosives Mod Fuels	\$65.00	\$68.00	\$71.00	\$75.00	\$79.00	\$83.00	\$87.00	\$91.00	\$96.00	\$101.00
Fireline Explosives Hvy Fuels	\$75.00	\$79.00	\$83.00	\$87.00	\$91.00	\$96.00	\$101.00	\$106.00	\$111.00	\$117.00
Slashing Light Fuels	\$65.00	\$68.00	\$71.00	\$75.00	\$79.00	\$83.00	\$87.00	\$91.00	\$96.00	\$101.00
Slashing Moderate Fuels	\$85.00	\$89.00	\$93.00	\$98.00	\$103.00	\$108.00	\$113.00	\$119.00	\$125.00	\$131.00
Slashing Heavy Fuels	\$95.00	\$100.00	\$105.00	\$110.00	\$116.00	\$122.00	\$128.00	\$134.00	\$141.00	\$148.00
Fuel Augmentation Lt Fuels	\$30.00	\$32.00	\$34.00	\$36.00	\$38.00	\$40.00	\$42.00	\$44.00	\$46.00	\$48.00
Fuel Augmentation Mod Fuel	\$40.00	\$42.00	\$44.00	\$46.00	\$48.00	\$50.00	\$53.00	\$56.00	\$59.00	\$62.00
Fuel Augmentation Hvy Fuels	\$50.00	\$53.00	\$56.00	\$59.00	\$62.00	\$65.00	\$68.00	\$71.00	\$75.00	\$79.00

APPENDIX G

Spring Burning Cost

(South/SE/SW Exposure) (4,000' + elevation) (Projects less than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Spring Burning - Helitorc	\$12.00 acre	\$12.50 acre	\$13.00 acre	\$13.00 acre	\$14.00 acre	\$14.50 acre	\$15.00 acre	\$15.50 acre	\$16.00 acre	\$17.00 acre
Spring Burning - Spherical Dispenser	\$18.00 acre	\$19.00 acre	\$20.00 acre	\$21.00 acre	\$22.00 acre	\$23.00 acre	\$23.50 acre	\$24.00 acre	\$24.50 acre	\$25.00 acre
Spring Burning - Hand Ignit.	\$25.00 acre	\$26.00 acre	\$27.00 acre	\$28.00 acre	\$29.00 acre	\$30.00 acre	\$30.50 acre	\$31.00 acre	\$31.50 acre	\$32.00 acre
Spring Burning - Helitorch	\$15.00 acre	\$16.00 acre	\$17.00 acre	\$17.50 acre	\$18.00 acre	\$19.00 acre	\$20.00 acre	\$21.00 acre	\$21.50 acre	\$22.00 acre
Spring Burning - Spherical Dispenser	\$20.00 acre	\$21.00 acre	\$22.00 acre	\$23.00 acre	\$24.00 acre	\$25.00 acre	\$25.50 acre	\$64.00 acre	\$26.50 acre	\$27.00 acre
Spring Burning - Hand Ignit.	\$30.00 acre	\$32.00 acre	\$34.00 acre	\$35.00 acre	\$36.00 acre	\$37.00 acre	\$38.00 acre	\$39.00 acre	\$40.00 acre	\$41.00 acre

Spring Burning Cost

(South/SE/SW Exposure) (4,000' + elevation) (Projects greater than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Spring Burning - Helitorch	\$20.00 acre	\$21.00 acre	\$22.00 acre	\$23.00 acre	\$24.00 acre	\$25.00 acre	\$26.00 acre	\$27.00 acre	\$28.00 acre	\$29.00 acre
Spring Burning - Spherical Dispenser	\$26.00 acre	\$27.00 acre	\$28.00 acre	\$29.00 acre	\$30.00 acre	\$32.00 acre	\$34.00 acre	\$36.00 acre	\$38.00 acre	\$40.00 acre
Spring Burning - Hand Ignit.	\$37.00 acre	\$39.00 acre	\$41.00 acre	\$43.00 acre	\$45.00 acre	\$47.00 acre	\$49.00 acre	\$51.00 acre	\$54.00 acre	\$57.00 acre
Spring Burning - Helitorch	\$26.00 acre	\$27.00 acre	\$28.00 acre	\$29.00 acre	\$30.00 acre	\$32.00 acre	\$34.00 acre	\$36.00 acre	\$38.00 acre	\$40.00 acre
Spring Burning - Spherical Dispenser	\$32.00 acre	\$34.00 acre	\$36.00 acre	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre
Spring Burning - Hand Ignit.	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre

APPENDIX G

Spring Burning Cost

(North/NE/NW Exposure) (4,000' + elevation) (Projects less than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Spring Burning - Helitorch	\$24.00 acre	\$25.00 acre	\$26.00 acre	\$27.00 acre	\$28.00 acre	\$29.00 acre	\$30.00 acre	\$31.00 acre	\$32.00 acre	\$34.00 acre
Spring Burning - Spherical Dispenser	\$36.00 acre	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$47.00 acre	\$48.00 acre	\$49.00 acre	\$50.00 acre
Spring Burning - Hand Ignit.	\$50.00 acre	\$52.00 acre	\$54.00 acre	\$56.00 acre	\$58.00 acre	\$60.00 acre	\$61.00 acre	\$62.00 acre	\$63.00 acre	\$64.00 acre
Spring Burning - Helitorch	\$30.00 acre	\$32.00 acre	\$34.00 acre	\$35.00 acre	\$36.00 acre	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$43.00 acre	\$44.00 acre
Spring Burning - Spherical Dispenser	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$51.00 acre	\$52.00 acre	\$53.00 acre	\$54.00 acre
Spring Burning - Hand Ignit.	\$60.00 acre	\$64.00 acre	\$66.00 acre	\$68.00 acre	\$70.00 acre	\$72.00 acre	\$74.00 acre	\$76.00 acre	\$78.00 acre	\$80.00 acre

Spring Burning Cost

(North/NE/NW Exposure) (4,000' + elevation) (Projects greater than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Spring Burning - Helitorch	\$32.00 acre	\$34.00 acre	\$36.00 acre	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre
Spring Burning - Spherical Dispenser	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre
Spring Burning - Hand Ignit.	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre	\$62.00 acre	\$65.00 acre	\$68.00 acre
Spring Burning - Helitorch	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre
Spring Burning - Spherical Dispenser	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre	\$62.00 acre	\$65.00 acre	\$68.00 acre
Spring Burning - Hand Ignit.	\$51.00 acre	\$54.00 acre	\$57.00 acre	\$60.00 acre	\$63.00 acre	\$66.00 acre	\$69.00 acre	\$72.00 acre	\$76.00 acre	\$80.00 acre

APPENDIX G

Summer Burning Costs

(South/SE/SW Exposure) (4,000' + elevation) (Projects less than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Summer Burning - Helitorch	\$330 acre	\$347 acre	\$364 acre	\$382 acre	\$401 acre	\$421 acre	\$441 acre	\$463 acre	\$486 acre	\$510 acre
Summer Burning - Spherical Dispenser	\$350 acre	\$368 acre	\$386 acre	\$405 acre	\$425 acre	\$446 acre	\$468 acre	\$491 acre	\$516 acre	\$542 acre
Summer Burning - Hand Ign.	\$500 acre	\$525 acre	\$551 acre	\$579 acre	\$608 acre	\$638 acre	\$670 acre	\$704 acre	\$739 acre	\$776 acre
Summer Burning - Helitorch	\$400 acre	\$420 acre	\$441 acre	\$463 acre	\$486 acre	\$510 acre	\$536 acre	\$563 acre	\$591 acre	\$621 acre
Summer Burning - Spherical Dispenser	\$450 acre	\$473 acre	\$497 acre	\$522 acre	\$548 acre	\$575 acre	\$604 acre	\$634 acre	\$666 acre	\$699 acre
Summer Burning - Hand Ign.	\$650 acre	\$683 acre	\$717 acre	\$753 acre	\$791 acre	\$831 acre	\$873 acre	\$917 acre	\$963 acre	\$1011 acre

Summer Burning Costs

(South/SE/SW Exposure) (4,000' + elevation) (Projects greater than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Summer Burning - Helitorch	\$430 acre	\$452 acre	\$475 acre	\$499 acre	\$524 acre	\$550 acre	\$578 acre	\$607 acre	\$637 acre	\$669 acre
Summer Burning - Spherical Dispenser	\$450 acre	\$473 acre	\$497 acre	\$522 acre	\$548 acre	\$575 acre	\$604 acre	\$634 acre	\$666 acre	\$699 acre
Summer Burning - Hand Ign.	\$600 acre	\$630 acre	\$662 acre	\$695 acre	\$730 acre	\$767 acre	\$805 acre	\$845 acre	\$887 acre	\$931 acre
Summer Burning - Helitorch	\$500 acre	\$525 acre	\$551 acre	\$579 acre	\$608 acre	\$638 acre	\$670 acre	\$704 acre	\$739 acre	\$776 acre
Summer Burning - Spherical Dispenser	\$550 acre	\$578 acre	\$607 acre	\$637 acre	\$669 acre	\$702 acre	\$737 acre	\$774 acre	\$8134 acre	\$854 acre
Summer Burning - Hand Ign.	\$750 acre	\$788 acre	\$827 acre	\$868 acre	\$911 acre	\$957 acre	\$1005 acre	\$1055 acre	\$1108 acre	\$1163 acre

APPENDIX G

Summer Burning Costs

(North/NE/NW Exposure) (4,000' + elevation) (Projects less than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Summer Burning - Helitorch	\$330 acre	\$347 acre	\$364 acre	\$382 acre	\$401 acre	\$421 acre	\$441 acre	\$463 acre	\$486 acre	\$510 acre
Summer Burning - Spherical Dispenser	\$350 acre	\$368 acre	\$386 acre	\$405 acre	\$425 acre	\$446 acre	\$468 acre	\$491 acre	\$516 acre	\$542 acre
Summer Burning - Hand Ign.	\$500 acre	\$525 acre	\$551 acre	\$579 acre	\$608 acre	\$638 acre	\$670 acre	\$704 acre	\$739 acre	\$776 acre
Summer Burning - Helitorch	\$400 acre	\$420 acre	\$441 acre	\$463 acre	\$486 acre	\$510 acre	\$536 acre	\$563 acre	\$591 acre	\$621 acre
Summer Burning - Spherical Dispenser	\$450 acre	\$473 acre	\$497 acre	\$522 acre	\$548 acre	\$575 acre	\$604 acre	\$634 acre	\$666 acre	\$699 acre
Summer Burning - Hand Ign.	\$650 acre	\$683 acre	\$717 acre	\$753 acre	\$791 acre	\$831 acre	\$873 acre	\$917 acre	\$963 acre	\$1011 acre

Summer Burning Costs

(North/NE/NW Exposure) (4,000' + elevation) (Projects greater than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Summer Burning - Helitorch	\$430 acre	\$452 acre	\$475 acre	\$499 acre	\$524 acre	\$550 acre	\$578 acre	\$607 acre	\$637 acre	\$669 acre
Summer Burning - Spherical Dispenser	\$450 acre	\$473 acre	\$497 acre	\$522 acre	\$548 acre	\$575 acre	\$604 acre	\$634 acre	\$666 acre	\$699 acre
Summer Burning - Hand Ign.	\$600 acre	\$630 acre	\$662 acre	\$695 acre	\$730 acre	\$767 acre	\$805 acre	\$845 acre	\$887 acre	\$931 acre
Summer Burning - Helitorch	\$500 acre	\$525 acre	\$551 acre	\$579 acre	\$608 acre	\$638 acre	\$670 acre	\$704 acre	\$739 acre	\$776 acre
Summer Burning - Spherical Dispenser	\$550 acre	\$578 acre	\$607 acre	\$637 acre	\$669 acre	\$702 acre	\$737 acre	\$774 acre	\$813 acre	\$854 acre
Summer Burning - Hand Ign.	\$750 acre	\$788 acre	\$827 acre	\$868 acre	\$911 acre	\$957 acre	\$1005 acre	\$1055 acre	\$1108 acre	\$1163 acre

APPENDIX G

Fall Burning Costs

(South/SE/SW Exposure) (4,000' + elevation) (Projects less than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Fall Burning - Helitorch	\$32.00 acre	\$34.00 acre	\$36.00 acre	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre
Fall Burning - Spherical Dispenser	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre
Fall Burning - Hand Ignition	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre	\$62.00 acre	\$65.00 acre	\$68.00 acre
Fall Burning - Helitorch	\$38.00 acre	\$40.00 acre	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre
Fall Burning - Spherical Dispenser	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre	\$62.00 acre	\$65.00 acre	\$69.00 acre
Fall Burning - Hand Ignition	\$51.00 acre	\$54.00 acre	\$57.00 acre	\$60.00 acre	\$63.00 acre	\$66.00 acre	\$69.00 acre	\$72.00 acre	\$76.00 acre	\$80.00 acre

Fall Burning Costs

(South/SE/SW Exposure) (4,000' + elevation) (Projects greater than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Fall Burning - Helitorch	\$42.00 acre	\$44.00 acre	\$46.00 acre	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre	\$62.00 acre	\$65.00 acre
Fall Burning - Spherical Dispenser	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre	\$62.00 acre	\$65.00 acre	\$68.00 acre	\$71.00 acre	\$75.00 acre
Fall Burning - Hand Ignition	\$54.00 acre	\$57.00 acre	\$60.00 acre	\$63.00 acre	\$66.00 acre	\$69.00 acre	\$72.00 acre	\$76.00 acre	\$80.00 acre	\$84.00 acre
Fall Burning - Helitorch	\$48.00 acre	\$50.00 acre	\$53.00 acre	\$56.00 acre	\$59.00 acre	\$62.00 acre	\$65.00 acre	\$68.00 acre	\$71.00 acre	\$75.00 acre
Fall Burning - Spherical Dispenser	\$54.00 acre	\$57.00 acre	\$60.00 acre	\$63.00 acre	\$66.00 acre	\$69.00 acre	\$72.00 acre	\$76.00 acre	\$80.00 acre	\$84.00 acre
Fall Burning - Hand Ignition	\$61.00 acre	\$64.00 acre	\$67.00 acre	\$70.00 acre	\$74.00 acre	\$78.00 acre	\$82.00 acre	\$86.00 acre	\$90.00 acre	\$95.00 acre

APPENDIX G

Fall Burning Costs

(North/NE/NW Exposure) (4,000' + elevation) (Projects less than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Fall Burning - Helitorch	\$64 acre	\$68 acre	\$71 acre	\$75 acre	\$79 acre	\$83 acre	\$87 acre	\$91 acre	\$96 acre	\$101 acre
Fall Burning - Spherical Dispenser	\$76 acre	\$80 acre	\$84 acre	\$88 acre	\$92 acre	\$97 acre	\$102 acre	\$107 acre	\$112 acre	\$118 acre
Fall Burning - Hand Ignition	\$88 acre	\$92 acre	\$97 acre	\$102 acre	\$107 acre	\$112 acre	\$118 acre	\$124 acre	\$130 acre	\$137 acre
Fall Burning - Helitorch	\$76 acre	\$80 acre	\$84 acre	\$88 acre	\$92 acre	\$97 acre	\$102 acre	\$107 acre	\$112 acre	\$118 acre
Fall Burning - Spherical Dispenser	\$88 acre	\$92 acre	\$97 acre	\$102 acre	\$107 acre	\$112 acre	\$118 acre	\$124 acre	\$130 acre	\$137 acre
Fall Burning - Hand Ignition	\$102 acre	\$107 acre	\$112 acre	\$118 acre	\$124 acre	\$130 acre	\$137 acre	\$144 acre	\$151 acre	\$159 acre

Fall Burning Costs

(North/NE/NW Exposure) (4,000' + elevation) (Projects greater than 300 acres)

Treatments	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Fall Burning - Helitorch	\$72 acre	\$76 acre	\$80 acre	\$84 acre	\$88 acre	\$92 acre	\$97 acre	\$102 acre	\$107 acre	\$112 acre
Fall Burning - Spherical Dispenser	\$84 acre	\$88 acre	\$92 acre	\$97 acre	\$102 acre	\$107 acre	\$112 acre	\$118 acre	\$124 acre	\$130 acre
Fall Burning - Hand Ignition	\$96 acre	\$101 acre	\$106 acre	\$111 acre	\$117 acre	\$123 acre	\$129 acre	\$135 acre	\$142 acre	\$149 acre
Fall Burning - Helitorch	\$84 acre	\$88 acre	\$92 acre	\$97 acre	\$102 acre	\$107 acre	\$112 acre	\$118 acre	\$124 acre	\$130 acre
Fall Burning - Spherical Dispenser	\$96 acre	\$101 acre	\$106 acre	\$111 acre	\$117 acre	\$123 acre	\$129 acre	\$135 acre	\$142 acre	\$149 acre
Fall Burning - Hand Ignition	\$108 acre	\$113 acre	\$119 acre	\$125 acre	\$131 acre	\$138 acre	\$145 acre	\$152 acre	\$160 acre	\$168 acre

APPENDIX G

Project Development Under the Ecosystem Maintenance Burning Plan

The following process can be used by the Lolo Forest in developing yearly project plans for the Ecosystem Maintenance Burning Program.

1. Based on expected budget levels, an Interdisciplinary (ID) Team should develop a program of work for review and approval by the Forest Supervisor. Contributions from functional areas will be developed at this time. The availability of dollars in various functional areas may be used to determine which management areas may be treated. The ID Team should be composed of individuals representing wildlife, recreation, fire, timber and ecology.
2. Ranger Districts should review this program of priority areas (MA-HG combinations) to be treated to develop project plans.
3. A review of the Forest Plan Data Base should provide a list of potential project areas that meet their assignment from item 1.
4. Conduct field review of potential project areas. Collection of vegetation presence lists on the major habitat types will be helpful in determining vegetative response that can be expected under various burning techniques. Assistance for this step may be obtained from the ecologist.
5. Based on the above information, develop area plans for long range goals for the project area and prepare an Environmental Assessment (EA) or Finding of No Significant Impact (FONSI.)
6. Use Table 6 in the report to help determine the appropriate functions to assess for each project.
7. If an area proposed for treatment by the Ranger District is not on the list of areas to be treated, or the treatment proposed does not follow that shown in Appendix F, a justification statement for treatment at this time or method must be included in the project proposal.

APPENDIX G

Distribution of Fuel Loading by Habitat Group in Undisturbed Stands

The following table displays fuel loadings by habitat group in Region 1. The values were determined from summary data included in the fuels photo series (William C. Fischer 1981).

Distribution of Fuel Loading by Habitat Group in Undisturbed Stands (Expressed in Tons/Acre)

Habitat Group	Frequency On Lolo	Number of Observations	Average <3"(t/a)	Average >3"(t/a)	Total (Range)	Total (Average)
0	9.42%	0	-	-	-	-
1	2.27%	2	2.1	3.1	3.8 - 6.6	5.2
2	17.31%	24	3.6	8.9	1.4 - 32.3	12.5
3	17.73%	9	5.1	14.5	7.8 - 33.3	19.6
4	28.07%	28	6.1	27.0	6.5 - 62.8	33.1
5	19.61%	5	6.1	7.7	3.5 - 23.9	13.8
6	6.22%	0	-	-	-	-

Although very wide ranges are indicated, the table may be useful in developing preliminary prescriptions, providing early indications of potential risk, or assessing dead and down woody material needs.

APPENDIX G

Seasonal Moisture Content Variation

The following values approximate moisture contents that reflect seasonal changes on south aspect, mid-elevation sites. These values assume steady drying over time until significant rainfall in early fall temporarily interrupts the trend.

	Sub-Surface Soil Moisture	FOLIAR Moisture	Lower Duff Moisture	1,000 Hour Moisture
SPRING				
Early	Over-Saturated	< 50%	> 250%	> 25%
Late	Saturated-Moist	250 - 300%	200 - 250%	20 - 25%
SUMMER				
Early	Moist-Slightly Moist	150 - 200%	100 - 200%	15 - 20%
Late	Dry	100 - 150%	50 - 100%	10 - 15%
FALL				
Early	Slightly Moist	50 - 100%	100 - 150%	15 - 20%
Late	Dry	< 50%	< 100%	10 - 15%

Surface soil moisture, upper duff, and fine fuel moisture contents will fluctuate rapidly in response to short-term, diurnal changes in temperature, relative humidity, and wind.

Although the above values are only approximations, they may prove useful in making out-year estimations of fire effects, risk assessment, and cost. It should be recognized that variation may occur between seasons for any given year.

APPENDIX H

**FRIENDS OF GRANT CREEK, Inc.
9280 KEEGAN TRAIL
MISSOULA- MONTANA 59802**

POSITION REPORT

**NORTHSIDE ANALYSIS AREA
July 12, 1993**

BACKGROUND

Friends of Grant Creek, Inc.

Friends of Grant Creek, Inc. (FOGC) is a nonprofit corporation founded in 1987 for educational purposes and to act as a vehicle for determining and expressing the will of the people of the Grant Creek Valley concerning issues of interest to the residents and property owners of Grant Creek. Membership in FOGC is open to anyone who resides or owns property within the Grant Creek watershed, north of Interstate 90. Others may join as non-voting, associate members.

FOGC is operated by a seven-member Board of Directors who are elected by the members. An effort is made to insure that FOGC Directors are elected so as to represent the various population areas within the Grant Creek Valley.

Northside Analysis Area

The management of the Lolo National Forest of the United States Forest Service has proposed forest management activities, some of which are expected to be within the Grant Creek watershed. These proposed activities are to include fire hazard reduction, wildlife habitat improvement, and timber harvest. This proposed activity has been labeled by the Lolo National Forest as the "Northside Analysis Area."

FOGC has determined to comment upon that geographical portion of the Northside Analysis Area which lies within the Grant Creek watershed. More specifically, the position of FOGC pertains to those proposed activity "units" of the Northside Analysis Area which lie wholly or partially within the Grant Creek watershed.

The response from FOGC to this Forest Service assertion is, show us. With the Northside Analysis Area, the Forest Service has the opportunity to "showcase" its current "best practice," forest management activities. FOGC challenges the Forest Service to demonstrate to the citizens of Grant Creek and Western Montana that it can implement forest management practices that are wholesome for the forest, and

are environmentally, aesthetically and economically acceptable to the citizens who use, appreciate and own the forests.

FOGC realizes that challenging the Forest Service to demonstrate its ability to manage the forest acceptably implies offering flexibility within which the Forest Service can make decisions and implement those decisions. That is the spirit of the position report. FOGC recommends general guidelines - limits of activity. Within those guidelines, the Forest Service, and its contractors and subcontractors, are expected to demonstrate the state of the art in forest management practices.

As this project progresses, and especially when it is concluded, the Forest Service can expect FOGC to focus careful scrutiny on the progress and results. The Forest Service can also expect FOGC to share its evaluation of the Forest Service's results with the public.

Impacts of Proposed Activities

FOGC is especially interested in impacts, both positive and negative, of the Northside Analysis Area activities. FOGC acknowledges that this forested area has been artificially managed for many years, largely by fire suppression, in a way that has created an abnormally high fire fuel load, an abnormally low amount of wildlife forage, and unnatural stands and mixtures of timber. We also understand that there may be some economic connection between Forest Service income from timber harvest in the Northside Analysis Area and the Forest Service's ability to accomplish the maximum amount of fire hazard reduction and wildlife forage enhancement.

FOGC encourages the most effective fire hazard reduction activity and the most wildlife forage enhancement possible in the Northside Analysis Area, realizing that fire hazard reduction and wildlife forage enhancement will require harvest of timber and thinning to reduce tree stand densities. FOGC also understands that timber harvest and stand thinning may be required to encourage certain species of trees and to reduce forest exposure to insect and mistletoe infestations.

FOGC encourages the minimum amount of timber harvest compatible with the economic viability of the project and with the goals of fire hazard reduction, wildlife forage enhancement, insect infestation prevention, desirable tree species encouragement and retention and maintenance of existing old growth stands.

FOGC Evaluation Process

FOGC has conducted numerous meetings of the Board of Directors to consider and evaluate the Northside Analysis Area proposal. Early in the process, FOGC designed a thorough questionnaire about the Northside Analysis Area and mailed it to all registered voters within the Grant Creek Valley. All persons eligible for FOGC membership were invited to complete this questionnaire and return it to FOGC. The results of this survey were released by FOGC in a separate report.

FOGC hosted a public meeting for Valley residents and other interested persons to which several independent experts were invited to make presentations on various technical aspects of the Northside Analysis Area proposed activities. Finally, members of the FOGC Board of Directors attended Forest Service tours of parts of the Northside Analysis Area, and of other properties in the Missoula area that had received treatments similar to those proposed for the Northside Analysis Area.

It is worth extra note that the people of Grant Creek are very interested in and concerned about the Northside Analysis Area. Although these people represent diverse views and attitudes, the FOGC Board of Directors believes that this position report represents a reliable consensus of the attitudes of Grant Creek residents and land-owners concerning the Northside Analysis Area.

Having received all of the input from the survey, the public meeting, and the tours, and having met with Forest Service staff, the FOGC Board of Directors has developed the position contained in this report. The position reported here may be considered the best available consensus position of the people of the Grant Creek Valley concerning the Northside Analysis Area proposal by the Forest Service.

FRIENDS OF GRANT CREEK POSITION Northside Analysis Area

"Showcase" Opportunity

To those expressing concern about the various impacts of the Northside Analysis Area proposal, the Forest Service has repeatedly answered that forest management practices have evolved considerably over the last few years. They also point out the dramatic difference between the forest management practices that are often viewed on the properties of large, private landowners, and the current best practices applied by the Forest Service.

The clear implication, if not a clear statement, from the Forest Service has been, "We can do better than the large, private forest managers, and we can do better than the forest practices applied by the Forest Service on public lands as recently as a few years ago."

Specific recommendation: Units 12 and 13 should be managed for old growth forest by ladder fuel treatment and other usual fire hazard reduction, with only enough thinning of old growth trees to protect remaining trees from risk of fire and infestations.

Specific recommendation: Consider redesignating units 12 and 13 to a designation that does not allow commercial timber harvest.

Roads. Access roads are an issue of major concern to FOGC. FOGC strongly urges that the extent of new roads built and old roads reestablished be kept to the absolute minimum within reasonable project viability.

The negative impacts of roads include visual aesthetics and post-project human ingress that would disrupt wildlife, generate litter, spread weeds, and increase threat from man-caused wildfires. The Forest Service seems to have been sensitive to the issue of road impact upon project visual aesthetics. Some proposed roads have been withdrawn from the proposal because of perceived negative impact on visual aesthetics. It is recommended that the Forest Service continue to keep project visual aesthetics high on its priority list.

Various mitigation strategies have been discussed to minimize post-project human ingress impacts on the Northside Analysis Area. Probably the best strategy is to simply build the least amount of road that is compatible with other project goals. FOGC feels strongly, to the point of being adamant, that any roads created or improved as part of the project should be effectively closed of motorized vehicular traffic upon project completion. To effectively close such roads, recontouring of the first segment of the roads appears to be a more desirable alternative than simply placing a gate on the road.

Specific recommendation: Due to steepness of slopes in the vicinity of proposed roads to units 12 and 13, and unsuitability of the area for recontouring of roads, any timber harvest in units #s 12 and 13 should be accomplished by helicopter.

Weeds. In addition to weed mitigation strategies employed during project activity, project plans must include active noxious weed control on logged, roaded, burned or disturbed areas for five- to ten- years after project completion.

Grant Creek and Snow Bowl Roads. The amount and nature of traffic on Grant Creek Road and Snow Bowl Road is also important to FOGC. FOGC feels strongly that only timber harvested within the Grant Creek watershed should be trucked over Grant Creek Road. Loaded logging trucks must not be allowed to traverse Grant Creek Road when the road is subject to season-oriented road surface damage, even if such restrictions are more restrictive than county or state GVW restriction. Effective dust control measures must be applied to the portion of Snow Bowl Road within the Grant Creek watershed.

Many people use Grant Creek Road for walking, jogging, and bicycling. Grant Creek Road is not a highway, but a residential arterial street. Project plans must ensure that Forest Service, contractor and subcontractor personnel will understand the nature of Grant Creek Road, and must conform the manner of their use to that nature.

Specific recommendation: Attention must be given to control of activity-related traffic, especially logging trucks, including hour of use (e.g., avoiding school buses and peak hour traffic), seasonal traffic limitations and weight limitations.

Conclusion

In conclusion, FOGC recommends a level of activity in the Northside Analysis Area that will accomplish the most effective fire hazard reduction, wildlife habitat enhancement, insect infestation prevention, and desirable tree species selection, with the least amount of road construction possible, with the least amount of post-project human ingress impact via project roads, with the least impact on Grant Creek Road and its users, insofar as all these goals may fit within the economic viability of the project. All of this would be accomplished as a "showcase" project by the Forest Service and its contractors and subcontractors.

End of Position

Friends of Grant Creek, Inc., Board of Directors

Emily Lauchnor, President

Bill Brunner, Vice President

Kim Brick, Secretary/Treasurer

Judy Barker

Ron Hoff

Gary S. Marbut

Randy White

APPENDIX I

AIR QUALITY

AIR QUALITY REFERENCE

For the Lolo National Forest

The following information is intended to facilitate evaluating air quality in NEPA documents which include prescribed burning. It follows Regional Office guidelines as documented in "Describing Burning Activities in NEPA Documents" sent out in November, 1993.

AFFECTED ENVIRONMENT

Regulatory Framework

Under the 1977 Clean Air Act amendments (4 U.S.C. /401 et seq), areas of the country were designated as Class I, II, or III airsheds for Prevention of Significant Deterioration purposes.

Class I areas generally include national parks and wilderness areas. Class I provides the most protection to pristine lands by severely limiting the amount of additional human-caused air pollution which can be added to these areas.

Class I airsheds on or adjacent to the Lolo National Forest are:

**Selway Bitterroot Wilderness
Bob Marshall Wilderness
Cabinet Mountains Wilderness
Mission Mountains Wilderness
Flathead Indian Reservation**

The remainder of the Lolo National Forest is classified as Class II airsheds. A greater amount of additional manmade air pollution may be added to these areas. No areas have been designated as Class III airsheds at this time.

The Forest Service will cooperate with the State to assure that State and Federal air quality standards are met or exceeded, and will meet constraints established by the Montana State Airshed Group's Memorandum of Understanding (Lolo Forest Plan, 11-17).

In Montana, the open burning season runs from March 1 through November 30. All open burning in the state is regulated by the State of Montana Air Quality Bureau. Major prescribed burners, including the Forest Service, have formed the Montana State Airshed Group. Through a Memorandum of Understanding with the Montana Air Quality Bureau, this group has established a smoke monitoring system that provides daily air quality predictions and restrictions to its members. Monitoring occurs during the months of September through November and is done by a monitoring unit consisting of meteorologists and technicians using weather forecasts, balloon soundings, burning plans, and air quality conditions to determine daily the need for restrictions on prescribed burning. The Forest Service is issued an annual permit to burn by the Montana Air Quality Bureau. Issuance of this permit is based on our participation and compliance to burning restrictions set by the Montana

Airshed Group. Prescribed burning is reported to the Airshed Coordinator on a daily basis. If ventilation problems are forecasted by the monitoring unit, prescribed burning is either restricted by elevation or curtailed until good ventilation exists.

From March through August, conditions are generally excellent for smoke dispersal due to normal strong wind patterns. The winter months of December through February are closed to all open burning due to the high occurrence of cold air inversions and the resulting poor smoke dispersal.

State Particulate Standards and Non-attainment Areas

The combustion products of prescribed burning include: carbon dioxide, water *vapor*, carbon monoxide, particulate matter, hydrocarbons, nitrogen oxides, and trace minerals. Particulate matter generally has the most potential for reducing air quality below State or Federal standards. Specifically, particulate matter less than or equal to 10 micrometers in aerodynamic diameter (PM-10) is the size which can penetrate the inner *recesses* of the lungs causing health problems. Montana standards are: 1) the concentration of PM-10 must not exceed 150 micrograms per cubic meter over a 24 hour period; or 2) the annual arithmetic average must not exceed 50 micrograms per cubic meter. Areas which the state has determined do not attain this ambient *air* quality standard are classified as "non-attainment" areas.

The Montana State Airshed Group has identified "impact zones" around the non-attainment areas in which emissions from prescribed burning could significantly impact the non-attainment area. Within these impact zones, the monitoring unit will use special care in regulating specific numbers, sizes, and locations of burns. Burning could be prohibited within the impact zones on days of marginal air quality, while it might be allowed on areas outside the impact zones.

Non-attainment areas on the Lolo National Forest are:

Thompson Falls

Missoula

Sensitive Areas

Impacts from any burning within the project area are usually felt downwind in an easterly direction since prevailing westerly winds are a dominant feature.

Sensitive areas include communities, Class I areas, non-attainment areas, developed camp grounds, and major transportation corridors which are near or down wind of the project area.

Analysis Area

Montana is divided into ten airsheds according to the Montana State Air Quality Bureau.

The Lolo National Forest covers parts of Airsheds 2, 3A, 3B, and 5.

Public Use

Describe public uses of sensitive areas, including season of use, type of use, etc.

Natural Conditions

Although there is no known historical air quality data, it is known that fire historically played a major part in the vegetative conditions of the area. Journals from early day explorers and newspaper articles from the late 1800's often mention the smokey conditions from fires burning in western Montana and northern Idaho (Losensky 1992). Fires ignited by lightning or by Native Americans would have generated smoke from as little as a few hours to as long as 90 to 120 days.

The annual amount of smoke generated from forest and range fires has generally decreased since the early 1900's, even with today's use of prescribed fire. Since that time, smoke has been reduced considerably due to the advent of a policy of suppressing fires on forests and grasslands.

Existing Conditions

Site specific info if available, including PM-10 ambient air monitoring data for non-attainment areas. Describe factors contributing to air quality, such as road dust, wood stoves, industrial, etc. Describe qualitatively if data not available.

ENVIRONMENTAL CONSEQUENCES

AIR QUALITY

Prescribed fire causes a temporary effect on air quality. Effects are dependent on the method of burn, the fuel consumed, and airshed characteristics that affect smoke dispersal.

Prescribed Fire Method

Underburning. The total fuel consumed by underburning is relatively low. To protect overstory trees, underburning usually uses slow burning techniques which reduce the heat generated both at the ground level and up in the tree crowns. This type of burning is therefore likely to burn with more inefficient combustion relative to other burning methods, creating more smoke. The relatively low heat generated by underburning is not effective at creating a convection column which would carry the smoke high into the atmosphere, so it is often more difficult to get smoke to disperse than with other methods which produce more heat.

Partial Stand Replacement and Stand Replacement. The fuel consumption in these types of burns is higher than in underburning. However, the drier conditions and increased heat produced in this type of burn favor more complete combustion and smoke dispersion high in the atmosphere.

Airshed Characteristics

The effects of smoke from prescribed burning within this project area are affected by the season of burning, the overall stability of the atmosphere, wind flows, topography, and the time of day that burning takes place.

Season. Spring and summer seasons have usually produced the best times for smoke dispersal, as daytime heating and general windflows help to raise smoke columns high into the atmosphere and disperse them rapidly. By mid-September, the air quality naturally begins to deteriorate as night-time inversions often develop. Inversions are hard to break during stable high pressure systems. The effects of prescribed burning on air quality are usually most severe from mid-September through November when smoke dispersal may be poor much of the time. During the cold winter months from December through February and on into March, air quality is the poorest. This is true although no prescribed burning is allowed from December 1 until March 1.

Atmosphere and Wind Flows. Stable high pressure systems are poor for smoke dispersal, especially during the fall and winter months. Inversions often develop where warm air at the higher elevations traps cold air and particulates in the lower elevations with very little wind flow. During the late spring and summer months there is usually enough daytime heating to lift smoke high into the atmosphere even during stable high pressure systems. Strong winds help to disperse smoke rapidly. Night-time downslope winds may carry residual smoke downslope, causing it to pool up at lower elevations, where it is usually dispersed by the following afternoon.

Topography. **Use site specific info.**

Time of Day. Smoke dispersal is best when daytime heating is greatest. This is usually when winds are the strongest also. The afternoon hours from 1:00 pm until about 6:00 pm have generally been the best times. Night-time burning is usually poor for smoke dispersal, as the cool downslope winds normally prevent the smoke from rising into the higher atmosphere. However, burning near ridgetops, even at night can be successful because ridgetops are exposed to the prevailing winds which often persist until after dark or through the night.

Summary of Emissions and Effects by Alternative

Summarize acres burned, type of burn, fuel consumption and emissions by alternative; provide comparative discussion of alternatives. Include effects of no action.

References Cited

Chapter 1: Ecosystem Management -

——— 1990. Annual Report, Lolo National Forest. USDA Forest Service. Missoula, Montana.

——— 1993. Kootenai National Forest Guide to Ecosystem Management. USDA Forest Service. Libby, Montana

Mrowka, Rob. 1993. Region 1 Ecosystem Management Field Assistance Trip Report. USDA Forest Service. Washington, D.C.

Spurr, Stephen H. and Barnes, Burton V. 1980. Forest Ecology. John Wiley & Sons: New York. Third edition. 438 pp.

Unger, David G. 1993. Statement of David G. Unger, Acting Chief Forest Service United States Department of Agriculture: Before the Subcommittee on Agricultural Research, Conservation, Forestry and General Legislation Committee on Agriculture United States Senate. Washington, D.C.

Chapter 2: Fire in the Ecosystem -

——— 1993. Fire Related Considerations and Strategies in Support of Ecosystem Management: Staffing Paper. USDA Forest Service. Washington, D.C.

Arno, Stephen F. and Keane, Robert E. 1993. Rapid Decline of Whitebark Pine in Western Montana: Evidence from 20-Year Remeasurements. Western Journal of Applied Forestry, Volume 8, No. 2. 44-47 pp.

Arno, Stephen F. and Fischer, William C. 1992. *Larix Occidentalis*--Fire Ecology and Fire Management. Presented at the Symposium on Ecology and Management of Larix Forests: A Look Ahead, Whitefish, Montana.

Bell, Lena, Grant, H.H. and Twogood, Phyllis. 1982. Bitterroot Trails. Bitter Root Valley Historical Society, Professional Impressions, Darby, Montana.

De Golia, Jack. 1989. Fire: The Story Behind a Force of Nature. Russell D. Butcher editor. KC Publications. Las Vegas, Nevada. 14-15 pp.

Fellin, David G., Shearer, Raymond C. and Carlson, Clinton E. 1983. Western spruce budworm in the Northern Rocky Mountains. Western Wildlands, Vol. 9:2-7.

Fisher, William C. and Bradley, Anne F. 1987. Fire Ecology of Western Montana Forest Habitat Types. 1980. USDA Forest Service. Gen. Tech. Rep. INT-223. Intermountain Forest and Range Experiment Station, Ogden, Utah.

Fritz, Harry. 1992. Fire: A Historical Perspective. The Power of Politics, the Media and the Public to Affect Wildland/Urban Fire Protection Programs in the 1990's: Proceedings from the 1992 National Symposium and Workshop. April 21-25, 1992. Glenda Wallace editor 69-71 pp. Missoula, Montana.

Gara, R. I., Littke, W.R., Geirzler, D.R., Driver C.H., and Agee, J.K. 1984. Influence of Fire, Fungi and Mountain Pine Beetles on Development of a Lodgepole Forest. Proceedings from The lodgepole Pine Symposium: The Species and its Management. May 8-10, Spokane, Washington. Washington State University, Pullman, Washington.

Gruell, George E. 1985. Fire on the Early Western Landscape: An Annotated Record of Wildland Fires 1776-1900. Northwest Science, Vol. 59, No 2. 102 pp. Missoula, Montana.

Hagle, Susan K. and Goheen, Donald J. 1984. Root Disease Response to Stand Culture. From the proceedings of a Symposium on Silvicultural Management Strategies for Pests of the Interior Douglas-fir and Grand Fir Forest Types. February 14-16, 1984 David M. Baumgartner and Russ Mitchell editors. Washington State University, Spokane. Washington.

Leiberg, J. B. 1900. The Bitterroot Forest Reserve. Department of the Interior, U. S. Geologic Survey, 20th. Annual Report, Part V. Forest Reserves, pp. 317-410.

Lanner, Ronald M. 1993. Is it Doomsday for Whitebark Pine? Western Journal of Applied Forestry, Volume 8, No. 2. 47 pp.

Lyon, L. Jack and Stickney, Peter F. 1976. Early Vegetal Succession Following Large Northern Rocky Mountain Wildfires. Proceedings from Montana Tall Timbers Fire Ecology Conference and Fire and Land Management Symposium, No. 14, 1974:355-375. Tall Timbers Research Station, Tallahassee, Florida.

Lucas, Eric. 1993. Burning Question: Thinning and fires prescribed for pest-infested forests. Horizon Air Magazine. March 1993 edition.

Losensky, B. John. 1984. An Assessment of Fire Effects on Lolo National Forest Ecosystems. 34-41 pp. USDA Forest Service. Lolo National Forest, Missoula, Montana.

Tiedemann, Arthur R., Conrad, C.D., Dieterich, J.H., et. al. 1978. Effects of Fire on Water: A State of Knowledge Review. USDA Forest Service General Technical Report WO-10. National Fire Effects Workshop, Denver, Colorado.

Vasechko, G.I. 1983. An Ecological Approach to Forest Protection. Forest Ecology Management, 5:133-168.

Chapter 3: Planning -

Apostol, Dean. 1993. 2nd Ditty on Landscape Ecology and Design...Eh? From a draft paper on landscape and design.

Arno, Stephen F., Simmerman, Dennis G., Keane, Robert E. 1985. Forest Succession on Four Habitat Types in Western Montana. General Technical Report INT-177. 74 pp. USDA Forest Service. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Fisher, William C. and Bradley, Anne F. 1987. Fire Ecology of Western Montana Forest Habitat Types. 1980. General Technical Report INT-223. 2-4 pp. Intermountain Forest and Range Experiment Station, Ogden, Utah.

Mueggler, W.F. and Stewart, W.L. 1978. Grassland and Shrubland Habitat Types of Western Montana. USDA Forest Service. General Technical Report INT-66. 154 pp. Intermountain Forest and Range Experiment Station. Ogden, Utah.

Chapter 5: Implementing Fire in the Ecosystem -

Mutch, Robert W., Arno, Stephen F., Brown, James K., Carlson, Clintoe E., Ottmar, Roger D., and Peterson, Janice L. 1993. Forest Health in the Blue Mountains: A Management Strategy for Fire-Adapted Ecosystems. USDA Forest Service. General Technical Report PNW-GTR-310. 3-7 pp.

Chapter 6: Public Involvement and Education -

Daniels, Orville. 1992. Good Public Relations Depends on Understanding the "Why." The Power of Politics, the Media and the Public to Affect Wildland/Urban Fire Protection Programs in the 1990's: Proceedings from the 1992 National Symposium and Workshop. April 21-25, 1992. 49-51 pp. Glenda Wallace editor. Missoula, Montana 59801

Devlin, Sherry. 1993. Grant Creek relents on logging. Missoulian. July 18, Section B. B-1 and B-6 pp.

Kemmis, Daniel. 1990. Community, Politics of Place. University of Oklahoma: Norman, Oklahoma.

Pyne, Stephen J. 1982. Fire in America: A Cultural History of Wildland and Rural Fire. Princeton University Press: New Jersey. 241 pp.

Schroeder, Herb. 1993. Ecology of the Heart: Restoring and Sustaining the Human Experience of Ecosystems. Presented at Connections Seminar Series, USDA Forest Service, Washington D.C.

Thomas, Jack Ward. 1993. Forest Management Approaches on the Public's Lands: Turmoil and Transition. Albright Lecture. University of California, Los Angeles, California.

Thomas, Jack Ward. 1993. Reinventing Conservation. USDA Forest Service Friday Newsletter. No. 12, 1690-3, Washington, D.C.

Appendix:

Davis, Kathleen M., Clayton, Bruce D. and Fisher, William C. 1980. Fire Ecology of Lolo National Forest Habitat Types. USDA Forest Service General Technical Report INT-79, 77 p. Intermountain Forest and Range Experiment Station, Ogden, Utah.

Pfister, R.D., Kovalchik, B.L., Arno, S.F., and Presby, R.C. 1977. Forest Habitat Types of Montana. USDA Forest Service General Technical Report INT-34, 174 pp. Intermountain Forest and Range Experiment Station, Ogden, Utah.